

P E R S O N A L

COMPUTER

EVERY THURSDAY

45p AUG 4 - AUG 10 Vol 1 No22

NEWS

THE COMPLETE COMPUTING WEEKLY

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Detailed guide to the
ins and outs of this O/S

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More games for the
Atari, 64, Spectrum and Oric

THE FORTH SPECTRUM
We compare new versions
of the go-faster language

IBM PLOT-TEST
Mannesmann Tally's new
colour plotter

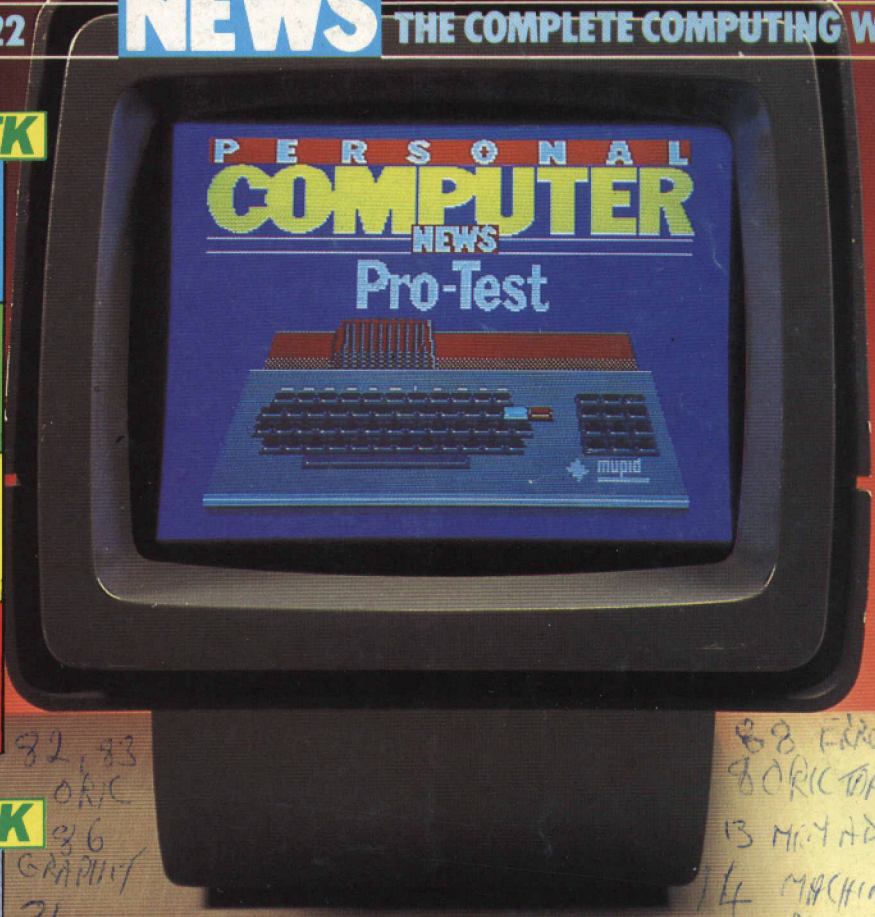
EVERY WEEK

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Weekly parade of
price-beating programs

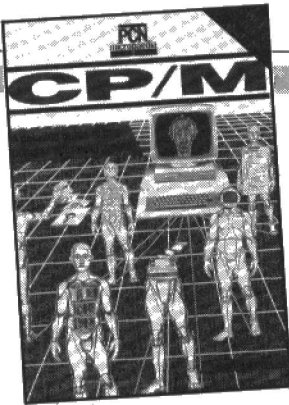
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Mupid:
the communicating micro



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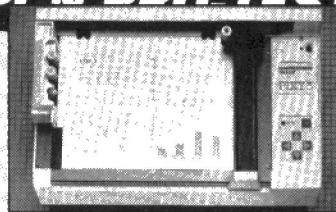
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At last . . . it's here

Given the lengthy run-up, it wasn't surprising that last week's Microdrive launch was accompanied more by a sigh of relief from Sinclair than the usual 'trumpet blowing'. In spite of the delay the ZX Microdrive storage system for the Spectrum is arguably the most important low-end product release of the year.

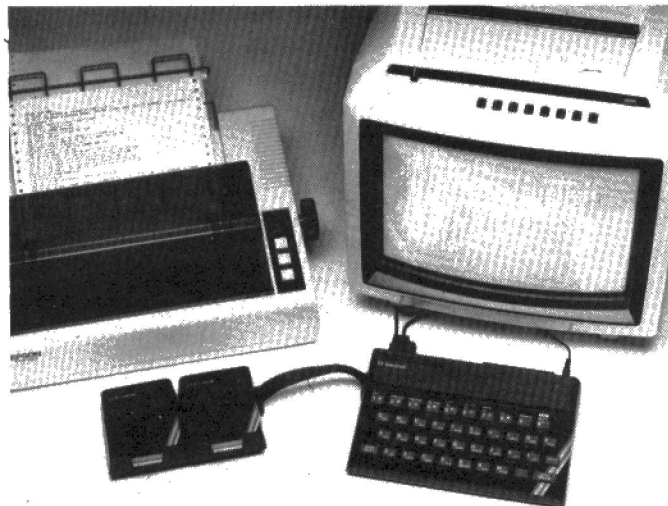
It would have been the most important low-end product release of last year, but the process of designing and setting up manufacturing and support took Sinclair Research longer than expected — much to the annoyance of Spectrum owners, many of whom viewed the Microdrive as the computer's principal feature.

But, the Microdrives have been worth the wait. The system uses, not a disk, but an endless tape cartridge about the size of a ROM chip. The ultra-thin tape inside is driven over a magnetic head at great speed, transferring data to the

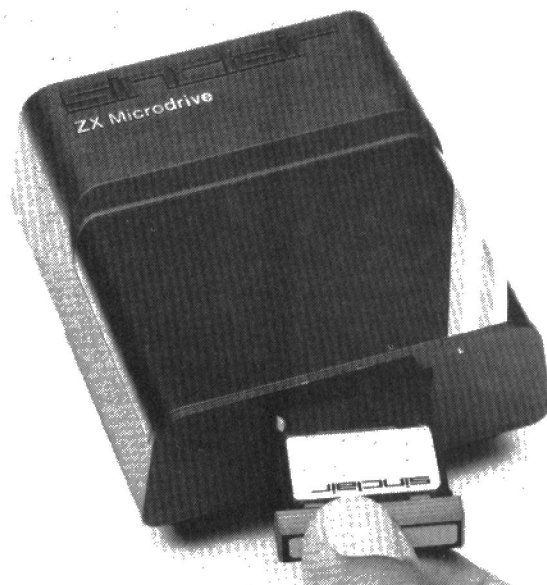
computer many times faster than a cassette tape.

As it's a 'loop' system there is no rewinding or fiddling to be done: all the commands to stop/start the tape or read/write, are handled by the computer by extensions to the Basic commands. In effect, it has nearly all the characteristics of a disk system. What you do lose for the cheap price tag is speed, so you could say the product is worth the wait in more ways than one.

There are two parts to the Microdrive system. The drive communicates with the Spectrum through a special interface (Sinclair calls it Interface 1; Interface 2 will apparently have a games cartridge slot and joystick controllers). The Interface sits behind and under the Spectrum, putting it on a comfortable typist's slant. The design has avoided repeating the infamous RAMpack wobble problem by providing screws to seat the inter-



The Microdrive Interface 1 includes an RS232 interface allowing connection with peripherals such as high quality printers.



ZX Microdrive: the launch that faced a thousand slips.

face firmly to the edge connector.

A ribbon cable from the Interface connects up to eight microdrives. These too can be screwed securely together.

As an added bonus the Interface has an RS232 interface and it also enables up to 64 Spectrums to be linked in a network to transfer data and share peripherals.

A single Microdrive costs £49.95 and the Interface £29.95. Bought by itself, the Interface costs £49.95.

The only chink in the Sinclair armour appears to be availability. It is expected that rationing (2 drives and 1 Interface per Spectrum) will be the name of the game until the end of this year. This, says Sinclair, is inevitable given the nature of the product. The company is unsure just what the take-up rate will be among Spectrum owners and how many drives they are likely to want to chain together, so Sinclair is being cautious with its production till it gets a clearer picture.

The same situation applies to the cartridge media, at least in the short term. Sinclair has protected itself against embarrassing over-demand by setting a fairly high price tag — £4.95 per cartridge.

Initially the drives and interface will be available only through Sinclair Research on a mail order

basis but will probably end up in the shops in a few months. For the time being it's a case of those who bought Spectrums first getting first byte at the drives.

The company has written to 100,000 Spectrum owners telling them to be patient. The lucky first few thousand owners have been sent order forms. (If you don't receive the 'please be patient' form within the next week or so you can put yourself on the waiting list by writing to Sinclair Research Ltd, Stanhope Rd, Camberley, Surrey GU15 3PS. Sinclair says there will be no queue jumping — everybody will have to wait their turn.

Sinclair describes the cartridge data capacity as at least 85K. This is because the formatting routine automatically identifies and ignores flawed sectors of tape.

A 48K program can be loaded in as little as 3.5 seconds — depending of course on where it's situated on the tape. If it happens to be the last program it takes longer.

Sinclair seems to have done it again. The Microdrive should have a major impact on the Spectrum software market, not only for games but for sophisticated personal/business software like spreadsheets or database applications.

Those great expectations

The Microdrives ceremoniously unveiled last week by Sinclair provided answers to most of the pre-production problems revealed by PCN. The Microdrives are indeed a revolutionary product, but:

- They have no random access; only limited serial access — so files are stored on a tape loop rather than floppy disk;
- They use a second operating system resident in the £30 interface module needed to run the Microdrives;

- You can only access one Microdrive at a time in order not to put more burden on the Spectrum's already overworked power supply;

- And it uses up some RAM in order to do error checking, although Sinclair spokesmen claim this shouldn't interfere with running long programs.

It seems whatever problems Sinclair had encountered with the RS232 interface in pre-production are now solved. But there are a few 'eccentricities' in

the Microdrive system we didn't predict.

Among these are:

- You cannot do Microdrive-to-Microdrive copying unless you LOAD information into the Spectrum's memory and then SAVE it to another drive;
- The Microdrive syntax is non-standard and will take a little getting used to for disk drive owners. To load a program from Microdrive, you type: `LOAD*“m”;1;“name”` — where 'm' specifies Microdrive, '1' is the

drive number and 'name' is the name of the file;

- The expansion interface needed to run the drives may not work with some 'real keyboard' add-ons for the Spectrum without modification. If your keyboard in any way covers up or goes underneath the Spectrum's expansion port, chances are the Microdrive interface won't easily fit.

- Next week we'll have a full Pro-Test of the Microdrive and Interface.

Safer by order

Mail order software houses have expressed support for a Computer Trades Association plan to protect consumers against mail order software houses that don't deliver.

If it goes ahead all mail order software houses will have to take out bonds with insurance companies to ensure they meet their orders within 56 days or return their customers' money.

But a quick survey of software houses last week suggested they didn't think the CTA proposals went far enough. All the companies surveyed said they were tired of being tarred with the brush of unreliability and expressed support for any moves to help improve their image.

'I would agree absolutely with the need for such a plan,' said Colin Miles of Astrocalc Software. 'And I think 56 days is far too long — I've got competitors who have been

advertising things that don't even exist.'

John Foster, from Dipack Software, agreed. 'I'm all for it, really,' he said. 'Anything like that must be a good thing.' He was surprised the CTA's suggestion for computer magazines to be involved in consumer protection plans had not already been picked up. The CTA has begun polling computer magazines in the hope of getting agreements that prevent non-bonded mail order houses from advertising.

Mr Foster said a variation on the plan has already been put into practice by many local newspapers. Software houses are required to sign a document ensuring they'll deliver their goods within a reasonable time in order to place an advertisement.

Bamby Software's Alan Balfe goes even further, suggesting all software houses should fulfill their

orders within four weeks. 'If you can't send your software out within 26 days, you shouldn't be in the business.' He said the increasing number of software houses failing to deliver mail-order is seriously damaging business for everyone else. His company, he added, makes nine out of ten deliveries within 48 hours of receiving the orders.

But he said he was concerned that the bonding requirement might make it more difficult for new companies to get into the mail-order software business, although a CTA spokesman said last week that the cost of bonding for a small company could be as low as £50.

Mr Balfe added that while supporting plans to protect individual customers against software delivery delays, there were cases where bulk orders could be delayed when they're made on short notice.

Cut-down Microwriter coming

Microwriters will soon be available in a new cut-down form.

They are intended as cheap, simple and easy-to-learn text-entry methods for the BBC micro, and are part of a complete system providing new applications both for the BBC, and for the Microwriter.

It might be thought that the chordal system used by Microwriter (01-831 6801) would be hard for children to learn, but it appears they have fewer problems than do adults. They don't seem to need to imagine letter shapes as a 'point of reference', and children of six have learned the system with ease.

The complete system will enable the BBC Micro to handle up to four keyboard-only Microwriters, which plug into the analogue input port on the back of the machine.

This avoids problems with RF interference, according to a company official, who explained that the system works by recognising a unique analogue value for each letter.

The computer can tell which of the keyboards is being used by looking at a signal on one of four pins in the port.

The company says the driving software, which is less than 1K, is interrupt-driven, so response-times are rapid.

Games have been developed for the system; they provide an enjoyable method of learning to control it. There will also be a straight teacher-program for adults.

The games so far announced are Codemasters, a mastermind-type code searching game, Wipeout, which is anagrams for up to four people, and Skram, rather like space-invaders, except that you have to hit the codes for the letters which replace the little monsters.

The first public showing of the system will be at the Acorn Users Show in three weeks' time. A single unit with supporting software will cost £50. They get cheaper as you buy more, so two cost £70, and three, £90.

Silicon trip

A ten-day trip to Silicon Valley, BBC micros and 48K Spectrums are prizes in a competition sponsored by the *Guardian* newspaper.

All you have to do is write a 1,500 word essay about 'business in the future'.

The competition is being run by the organisers of the International Business Show, which takes place in Birmingham in October.

Entrants are asked to take an 'objective and fresh look' at what the future holds for office workers and executives. In particular, the judges will want to read about the impact of networking and people being able to work at home.

The competition closes on September 16 and the winning entry will be printed in the *Guardian*.

Further details from the IBS Information Centre, Hesketh House, Portman Square, London W1.

Making fun of maths

A bit of fun has been thrown into maths learning with three new games for the Apple II+ (48K) micro from Pete and Pam Computers (0706 212321). Aimed at five-year-olds and upwards, each package cost £20.94 each and consists of two programs.

First there's Golf Classic and Compubar — Golf Classic is a game designed to develop geometric skills and encourages the child to estimate angles and distances. Compubar helps children learn to read graphs and to construct arithmetic expressions.

A couple of counting programs are Aliencounter and Face Flash. In Aliencounter there's a space ship full of aliens. A number appears in the sky and your objective is to successfully land that same amount



of aliens. If you get it right 10 times in a row, you're rewarded by a visual display of fireworks.

In Face Flash up to 49 faces flash onto the screen for a short time, then you're asked how many there were.

There are brain teasers also, Frenzy and Flip Flop. In Frenzy you must try to answer 20 problems before a hungry alligator eats 10 fish. If you've saved any fish you'll be able to play the bonus game. When you play Flip Flop you're shown two figures or shapes and you've got to decide if the figure on the left can be moved to look exactly like the one on the right — both in colour and shape.

Working with micros

Sixteen-year-old school leavers wondering what to do after the summer hols, can join the Computer Insight Youth Training Scheme and learn about microcomputers. There are still 100 places up for grabs.

The first group of 30 trainees will begin the course on September 5 followed by three weekly intakes of 30 trainees.

Gordon Kelly, managing director of Computer Insight, has been appointed as managing agent under the scheme. He said: 'We are not aiming to make experts of the trainees, but highly useful members in a micro-based team.'

'Their work experience will be

geared to whatever they're doing. Our people are going to be leaving the course with an appreciation of the micro.

'We're filling a gap between school and work. And all the lecturers are still participating in the micro field, which I think is very important.'

So far, filling places for the scheme has been rather slow, with only 20 places being taken up out of 120. But Mr Kelly thinks things will start taking off now, when many school leavers are at a loose end.

As part of the course trainees will be sponsored by a company for 37 weeks and for 13 weeks attend lectures on aspects of microcom-

puting.

Several retail stores and companies have taken on trainees, and it is during this period that the students will have to complete a project.

While on the course trainees will receive £25 a week, though there's no guarantee there will be a job opening when the course ends.

'We have been contracted to run the course on an annual basis,' said Mr Kelly. 'But we hope it will run for longer. It may be possible to expand the course if the demand is there but this will depend on the Manpower Services Commission'.

More details from Gordon Kelly, 01-699 6202.



VIEW FROM AMERICA



Chris Rowley

Micro makers get the heat treatment

Summer in the USA is generally hot as blazes and dominated by dog day stories about the staples of life — heat waves, baseball, missile systems and Cuba, outdoorsy stuff.

Business is a little flat, the executive suite is on vacation, time for beaches, boats and bikinis, except for those poor devils being dragged through the Louvre on the almighty dollar.

But the microcomputer scene isn't going to the beach. People there are nailing themselves to the desk.

In the home computer and video games sector something called the Free Market is having its terrible way and heads are rolling. At the same time the silicon war with Japan has seen new and intriguing manoeuvres.

There's been a rush to put ace marketing guys at the helm of companies that fear they lack marketing skills. Adam Osborne, having somehow survived the disaster of April, has put things in the hands of Robert Jauch, a marketeer from Consolidated Foods.

At Apple they brought in John Scully from Pepsi Cola, while Steve Wozniak returned to the fold to come up with new inexpensive Apples. Everyone is painfully aware that IBM is running five per cent of Apple.

As the red ink turns into a red sea at Atari and parent giant Warners recorded a stunning \$283 million loss, Raymond Kaffar was replaced by James Morgan — known as 'Marlboro Man' — and one of Philip Morris' best marketing minds.

'From bucks to bytes' chorused the Press. Mr Morgan intends to keep Atari moving away from the video game market — now characterised as a 'crap shoot for great white sharks' and towards computers, currently only 21 per cent of Atari's business.

Atari also faces unionisation problems in California as a result of job losses to South East Asia.

At Mattel, which joined Texas Instruments in the \$100 million loss league this quarter, they have brought in Mack Morris, another market gunslinger.

Mattel's problems in video games are said to be severe. They may even pull out of the whole area and stick to toys, where the company is still strong.

Elsewhere the downward spiral on hardware and software prices continues unabated:

- In one NYC deal an Osborne 1 comes for \$1,250.
- As a result of a deal with Tandon disk drives, Kaypro II prices will come down soon to \$1,395.
- Apple II systems with one disk drive are down to \$1,500.
- ZX81s are loss leaders at \$35, about the same as a Walkman.

Competition is red hot. All eyes are on the \$600 Coleco Adam home system. If it does well then not only will Coleco have pulled off another coup but systems will be the wave of the future.

But the wave of now seems to be IBM, which saw total earnings soar 24 per cent to a whopping \$1.34 billion in the second quarter. Demand for PCs and XT's is so intense there is a month's delay in most markets.

The chip wars saw Zilog, a subsidiary of Exxon, go to the International Trade Commission for an investigation of NEC Japan. Zilog charges patent, trade mark and copyright infringements. This time next year, if Zilog charges are upheld, NEC's chips and anything with an NEC chip in it could be banned from the US.

Again analysts of this market are continually confounded by new breakthroughs.

Wang Laboratories, normally known for mini computers, has announced Single In-Line Memory Modules (SIMMs) which cram nine 64K RAMs into a space three inches by 0.75 inches. Wang believes SIMMs will provide significant competition to the new Japanese 256K RAMs which, initially at least, will cost much more. Already US firms are lining up to make SIMMs, and Texas Instruments intends to use them in a new generation of machines.

Nowonder noone in the microcomputer business can take a vacation.

The fame game

Hot on the heels of Virgin, another record and video company is planning to break into the computer games market. And it is on the look-out for programmers.

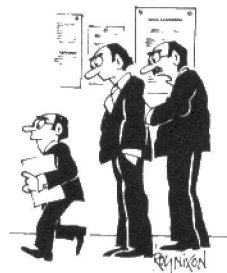
Mogul Software (01-437 3156) has been set up by Mogul Communications, which features on its video and record labels famous names like Bob Marley, Chuck Berry, Telly Savalas and James Mason.

It is now looking for people who want to become equally famous in the world of computer games.

The company says it will pay 'big royalties for big ideas' but refuses to be drawn on how much this will be. It will be up to individual programmers to negotiate the best deal they can get.

Unlike some software houses, Mogul is not insisting that programmers join the staff or sign an exclusive contract for all the games they produce.

With more companies moving into the games market the opportu-



'Have you noticed how much smaller computer programmers seem to be getting these days?'

nities for the freelance programmer are wide open. If you come up with an idea for a new game and can write in machine code you can now play one software company off against another when negotiating royalties.

The person to get in touch with at Mogul is Des Dolan, the managing director, who says, 'We're looking for programming frontiersmen who are not afraid to be adventurous and break new ground.'

Sig/net swans around in colour

A bit of colour has been added to the Sig/net 2 micro with a new graphics module called Graph-Video.

With 512 × 256 pixels the package gives black, white and six shades of grey on a monochrome

monitor and on a colour monitor gives eight different colours.

Another feature of the graphics facility is the built-in vector generator. This provides very high speed plotting for the fast production of line drawings. To enable users to draw pictures easily, a CP/M to Basic software interface is included in the graphics package.

For £313.95 you get power-cables and a demo-disk with software interface. Contact Shelton Instruments, 01-278 6272.



Chartech makes word processors scientific

Word processors on micros can be really fine when humbly processing simple text. But give them something scientific or technical and they seize up.

Even the granddaddy of them all, Wordstar, is not immune to the problem. But no longer.

Impex Microproducts (0525-371597) has produced Chartech, an extension to Wordstar that allows it to function as a scientific/technical word processor.

For £76 you get the ability to manipulate and print out Greek and mathematical symbols on printers with dot-addressable graphics. Complicated equations and complex fractions can be displayed together with multiline expressions.

There are 94 special characters available. And if you want more you can create your own.

The package is, however, available only for Osborne micros.

Aquarius in control

Control the world for under £250! (Well, your house and garden, and possibly your neighbours, anyway). Save energy, protect yourself against attack! Learn to play the guitar in hours!

Most of these things are now available at a practical price, courtesy of Mattel and its latest product, a small and affordable yet expandable home computer.

Speaking at the launch of the Mattel Aquarius last week Michael Lunch, MD of the UK division, announced a forthcoming add-on which will allow almost any electrical device to be turned on, up, down or off at the computer's command.

The Aquarius, a Z80-based machine which we reviewed in issue 7, looks at first sight to be a rather ordinary home computer. In many ways it is, and Mr Lunch didn't deny it, saying the company is 'not expecting to give IBM any sleepless nights' with it.

However, with the announcement that the complete system, consisting of the Aquarius itself (4K RAM expandable to 52K, 8K Microsoft Basic in ROM, 40 × 24 16-colour display with 320 × 192 graphics, sound-generator, all for £79.95), plus a printer, expander unit, expansion RAM, ROMpack programs and plenty more to come, Sir Clive may toss and turn a bit.

With the announcement of an X-10 controller-system as an add-on, as well as proper disk-drives and a modem, the little blue and grey box virtually guarantees nightmares for makers of other machines, and takes off on its own path.

The drives (specs not yet



Aquarius with home control system and appliance modules.

announced) appear to be 5¼in. The modem is a small plastic plug-in module, the same shape as a ROMpack.

Since it has its own keyboard, the X-10 controller is styled like the computer itself, and sits beside the machine. It is connected to the mains by a single cable, with another, for use only when re-programming, which goes to the computer.

The simplicity and cheapness was a great surprise to Stirling Moss, who was invited to see how things have progressed since he built his six-level architect-designed house with full distributed control to turn on or off almost anything in his house from any room.

This system works, but only by having 107 separate circuits, and Mr Moss admits that even though he can run a bath to the right depth and

temperature from anywhere in his house, his system couldn't do as much as the Aquarius promises.

The way the X-10 system controls an electrical appliance is simple. A special adapter (about £10) is put in a power-socket, and the electrical device — a lamp, for example — is plugged into the adapter.

When the lamp is to be switched on, the X-10 controller sends a coded pulse down the ordinary mains cable. Each X-10 power-adapter can be programmed to recognise any one of 256 codes, and when a pulse which matches the programmed code is sent, the adapter switches on.

Even more cleverly, each adapter can be a dimmer, too. So you can dim the light in the children's room, for example.

The program is set by plugging a special cartridge into the computer,

which shows pictures of a generalised house. Each room has several places to put an appliance, and there is a range of appliances to choose from.

Once the X-10 is programmed, the computer isn't needed, so it can be uncoupled and used for other tasks.

Programs are being supplied either as ROMpacks, as with Fin-form, the spreadsheet, and File-form, a card-index, or from third-party software houses on cassette.

Among the early releases will be Logo, Extended Basic, Chess, some adventures, and Burger Time, described as the 'hottest videogame in the US at the moment'.

An interesting aspect to the promotion of the Aquarius is that Mattel has arranged with major computer-book publishers to have books about their machine produced as soon as possible.

The Aquarius will be sold in High Street outlets such as Menzies, Smiths and Boots, but also by mail order and catalogues through companies such as Argos.

The basic unit will cost £79.95, the printer £139.95, the data-recorder £49.95, and the 4K and 16K RAMpacks £19.95 and £29.95 respectively. Software will be sold in three price-bands, A at £19.95, B at £24.95, and C at £49.95. All these should be in the shops now.

Prices and release dates for the other units have not been announced, but the X-10 system is expected to cost about £100 for the controller and two adapters, with extra adapters at £10. They should be available early next year.

High-profile Microdecision

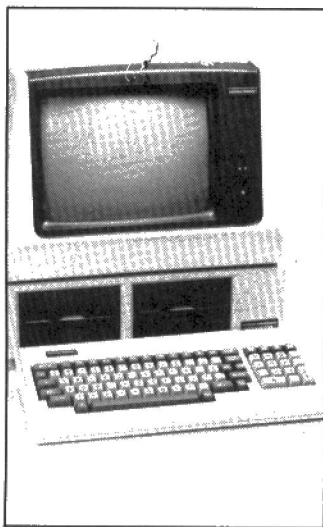
Morrow Designs' low-cost CP/M business system, the Microdecision, has been given a boost with a change of distributor.

This cheap and cheerful micro has been available in a quiet way in the UK through Clenco and Interam. Now distribution is in the hands of Televideo suppliers Midlectron (077382-6811).

The Microdecision is a standard CP/M machine designed to run hundreds of proven packages. The hardware is a Z80 and 64K RAM and two 250K or 500K floppy disks. Free software includes Wordstar and the Correct-it spelling checker, a spreadsheet called Logicalc and Microsoft's Basic-80 as well as the North Star-compatible Basic.

Morrow Designs is also offering a menu-driven front-end for CP/M which displays the full range of CP/M functions and turns error messages into plain English.

Prices start from £1,020 for a twin 250K machine without a terminal. A complete system supplied with a Televideo 910 terminal will cost £1,495 though you may already own or be able to provide your own terminal.



Microdecision from Midlectron.

Xenix triplets

Unix-by-numbers is the latest development from Microsoft, which has just released version 3 of its Xenix operating system, up for sale in three separate chunks.

Xenix version 3.0 is to make its first appearance on the Lisa, around the end of next month, and of course it's mouse-compatible. Versions for various other 8086 and 68000-based micros are planned to follow, with existing Xenix-based machines such as the Altos looking likely to go for the new version. Logica will be selling the system.

The new-look three-part Xenix is designed to fit better onto micros than past Unixes have been able to do. This is done by siphoning off most of the vast pile of programming tools and utilities and selling them as a separate module, with text processing software as another module, leaving a relatively small run-time module as the core of the system.

According to Carl Phillips, Microsoft's technical support manager, the run-time system is suitable for people wanting to run just packaged applications. It handles input-output functions, memory management, and includes Microsoft's 'Visual Shell' user interface — a list of the main operating system commands in a window at the bottom of the screen, through which users can tab the cursor to the command of their choice. It will also read and write MS-DOS files.

'This release of Xenix is oriented much more towards micro users,' said Mr Phillips. 'So all the mini-computer-oriented utilities from Unix Systems 3 and 5 have been taken out and put into the software development module.'

That includes tools such as the C compiler, the symbolic debugger, and the assembler. There's also a source code control system to keep track of program changes.

Teachers lag behind

By Sandra Grandison

Despite the Government pumping cash into schools to buy computers, once they're installed in the classroom there are still problems.

Teachers meeting in Nottingham last week spoke of their concern. Many among their ranks don't have the knowledge to use the micros to their full capacity. They complained that training was insufficient and that they had little opportunity to teach themselves.

'Because you're a teacher you're supposed to have all the answers. But in many cases the pupils know more about the machine than you do,' said one delegate at the three-day Micro Computer Users in Education (MUSE) conference.

'We don't get enough training and personally I don't have enough spare time to learn it properly. Teaching is a very competitive

profession now and jobs are short,' she said.

'And if only one teacher in a school is trained in the computer field, it's an added bonus because they might want to keep the knowledge to themselves and not pass it on.'

Max Bramer, director of the East Midland Region of the Microelectronics Education Programme (MEP) said: 'There are not enough educational computer centres. At the moment there are 14 MEPs dotted around the country serving several local education authorities.'

'Many teachers are unable to visit these centres because they haven't the time and they're too far away. What might be a good idea would be if some sort of mobile service went to various localities for a week or so, and schools plus visitors could have expertise on hand. Something like

the Bedfordshire Education Authority is doing.' (PCN, Issue 21). But with the current cut-backs such a national scheme seems unlikely to happen.

Anxiety about the computer literacy of teachers was a major topic brought out at the conference, which attracted more than 300 delegates from as far as Trinidad, Bermuda and Pakistan.

As Andrew Hopkins, chairman of MUSE explained, the organisation's aim is to further the knowledge and practice of all aspects of technology used in education.

During the three-day event teachers listened to talks on different aspects of computers in the classroom. 'Introducing Logo in the classroom' and 'Microcomputer interfacing in the science laboratory' were two favourites.

Dr A Allen of Norwich City

College discussed how a micro connected to a science apparatus can be a powerful learning aid in demonstrations and student experiments. And with minimal additional hardware a micro can be connected to a variety of sensors and control devices.

Educational software also produced much interest. Companies large and small showed software running mostly on BBCs and Research Machine's Link 480Z.

Cambridge Software will release new packages for the Beeb in a couple of weeks. There's Map Skill 1, which teaches elementary mapping skills, Moving Molecules, which shows simple kinetic theory to explain Charles' and Boyle's laws, Watts in your Home, to calculate the cost of energy-consuming devices, and Balance Your Diet. Each costs £15.57.

Osborne and Epson à la modem from K & N

Users of portable micros wanting to phone home should first give K & N Electronics a call on Maidenhead (0628) 22447.

The company has brought out a new acoustically coupled modem to work with the Osborne I and Epson HX20.

The KN890/OS costs around £175 and sends data down the telephone lines at a rate of 300 baud.

It has full duplex operation and is British Telecom approved.

The company claims the modem's self sealing rubber cups provide excellent immunity to ambient noise. It also says the cups have been designed to suit most European and American handsets.

The version for the Epson HX20 comes with its own battery power supply which can be recharged via the Epson.

The one for the Osborne uses the Osborne's own power supply and has an interface tailored to fit the modem port.

Blast your own EPROMs on the IBM

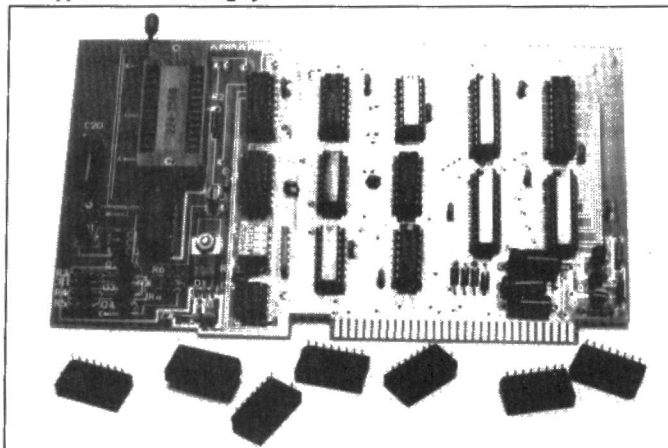
IBM PC users who want to transfer data from RAM to EPROM can slot in an Apparat PROM Blasting System in their machine. For £166.95 you get an interface card, a

The Apparat PROM Blasting System.

complete set of personality modules, software on disk and an instruction manual. The software will run under PC DOS.

The system is distributed by Pete and Pam Computers (01-769 1022).

The company says the system will program virtually all of the common 24 pin EPROMs. Some of the Apparat PROM Blaster capabilities include — Verify, read, copy and program the EPROM.



The HX20, calling up its pals.

Epson HX20 cross-talk

Epson HX20 users can now talk to other micros with a new device called ITE+ from Transam (01-405 5240)

ITE+ plugs into the back of the HX20 or fits into the expansion slot. The software can act as an editor or transform the HX20 into an intelligent terminal attached to another computer.

With the ITE+ ROM fitted in its place, you can give instructions or receive information from any asynchronous computer via a cable or a telephone line.

As part of its dual role the ITE+ can be used for editing text either to prepare data for transmitting, or for reviewing and editing messages

received by the terminal from another computer.

The text, once prepared, is saved to a file and can be sent using the terminal.

The editor uses the screen of the portable, and scrolls left and right for full line length. For viewing and correcting you can display a single line at a time, using the four lines of 20 columns to display 80 columns of text.

For £52.50, ITE+ can also print a full 80 column line, by printing the text sideways in blocks of 18 lines.

Also available for £89.25 is the Transam parallel interface which allows printing to a parallel printer from the HX20.

Sirius network

ACT is to bring out a networking system for the Sirius.

Based on Omninet, one of the front runners in the race to establish the industry standard, it will offer micro to micro communication at a data transfer rate of one megabit per second.

Each Sirius in the network will be equipped with a networking board and linked with others by a 'twisted pair' cable. The machines can be up to 1,500 feet apart without the need for signal repeaters.

The network will allow the micros to share a 10Mb hard disk file server while retaining their own local processing power and optional disk file storage.

The file server is essentially a 256K Winchester Sirius with its own internal intelligent network base, but without a screen and keyboard.

The system contains three levels of protection to prevent unauthorised access to files on the hard disk. Files can be designated 'read only', a locking mechanism can restrict concurrent access, and files can be designated for exclusive use.

A maximum of 54 Sirius computers and ten file servers can be linked into the network.

Future enhancements to the system include the ability to attach a wider range of peripherals.

Costs vary according to facilities required. A 256K Sirius with no disks but with network board, connectors and software will cost £2,179. A networking upgrade to an existing Sirius will cost £569. And the file server with networking hardware and software will cost £4,134. Deliveries are expected to start by the end of August.

Get in the know at the Poly

Expert systems will be spotlighted during a two day course at the Polytechnic of North London.

The 1983 Expert Systems Weekend will be held on September 10 and 11 and organiser Richard Forsyth says it will concentrate on the techniques needed to build

knowledge-based systems.

Expert systems have the capacity to 'learn' and gather more knowledge the more they are used.

Speakers are active in the field of knowledge-based systems, and the course costs £64 including lunches and dinner. Those not living in the London area will need to fork out an extra £8 for bed and breakfast.

Further details from Mr Forsyth at the Department of Mathematics, Statistics and Computing, Polytechnic of North London, Holloway, London N7, tel: 01-607 2789 Ext. 2316.

Hobbit forms

Hobbit-fever is about to hit the ranks of Oric owners, as the top-selling adventure game from Melbourne House makes its way from its Spectrum origins onto the 48K Tansoft machine.

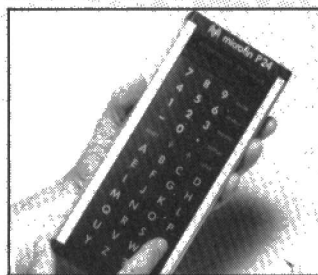
Late September is the date Tansoft has earmarked to start shipping copies of The Hobbit, priced at the same level as the Spectrum version, which is currently going for £14.95. The program has been a roaring success among Spectrum owners, and recently reached Number One in the PCN software sales charts.

Publisher Melbourne House is doing the software conversion, and

Tansoft will distribute the game, which will be available at Oric dealers. It will come with a copy of the Tolkein novel which inspired the program.

The Hobbit has attracted a great deal of attention for its almost artificial intelligence-like software-style.

The storyline follows that in the novel, where Bilbo the Hobbit and Thorin must seek Smaug the dragon's treasure hoard, but unlike most adventure games, the characters in this one seem to have a life of their own. They frequently act and react independently of any commands given by the game player.



HANDY DIGITS—A new range of hand held data capture terminals has emerged from Microfin Systems. Priced from £495 to £795 the 'F' Series consists of four models with fixed PROM suitable for repetitive data entry in a fixed format. The four programmable models in the 'P' Series can be used for any data capture applications as programs can be downloaded into the RAM memory when needed. Prices range from £695 to £995. Contact Microfin, 0932 53488.

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Telewriter (Microdeal)
Strategic Command (Romik)
Warlord (Lothlorien)
Wizard War (Salamander)
Golf (Salamander)
Prima (Automata)
Chess (Dragon Data)
Banking/Bank Rec. (Hilton)

FOR DRAGON

Killer Gorilla (Prog Power)
Road Runner (Superior Soft)
Moon Raider (Prog Power)
Frogger (Various)
Snapper (Acornsoft)
Painter (A&F)
Castle of Riddles (Acornsoft)
Centipede (Superior Software)
Alien Dropout (Superior Software)
Meteors (Acornsoft)

DISC DRIVES: From £199 — LVL (Shugard), Kumana (TEAC), Canon.

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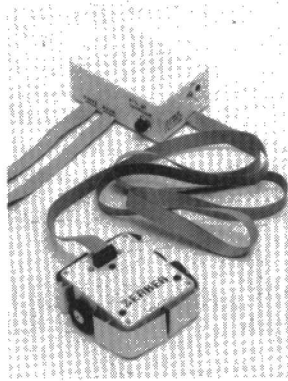
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Available as a kit or assembled, at prices unmatched by any other turtle! Includes umbilical cable, control station and manual. (All software, and interfaces for ZX81/Spectrum extra).

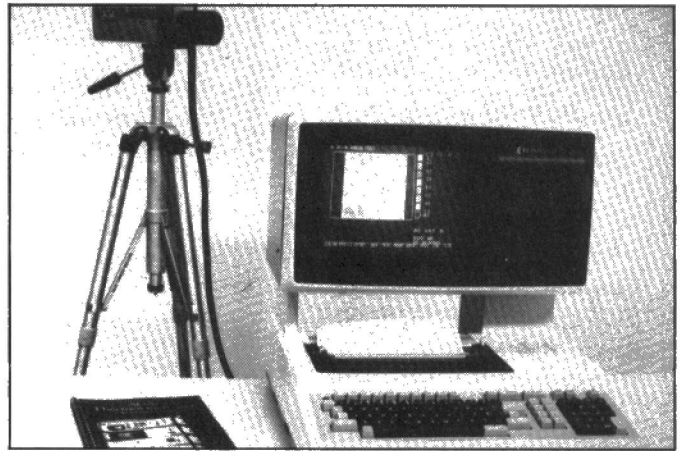
Higher Oki

Japanese micro company Oki has brought out a special version of its BMC Oki if800. It is aimed at scientists and engineers, and makes the most of the micro's high resolution colour graphics.

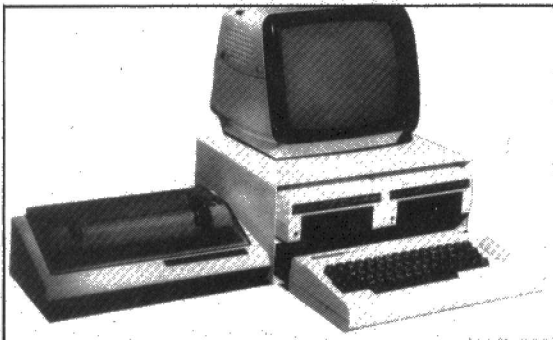
The model 30 costs £4,922 and is distributed in this country by Encotel Systems (01-686 9687). It is a complete workstation comprising 128K of RAM, two 1 Mb 8in floppy disks, colour monitor and built-in dot matrix printer. And it runs CP/M.

The screen resolution is 640 by 400 pixels with 25 lines of 80 characters in a combination of eight colours. Hard copy can be obtained using the built-in printer, which has a full colour graphics capability.

One of its first patrons is Aga Infrared Systems, which is using the model 30 as part of its Thermovision image processing system. The system is used to identify temperature differences in objects and materials, including heat-loss from poorly insulated buildings.



BMC if800 terminal analysis system model 30, as used by Aga Infrared.



TAKE A STAND — If you're tired of your monitor and disk drives being shifted from place to place, why not put them in an A-Stack? It has been designed with the Vic 20 and Commodore 64 in mind, but is suitable for most micros. For £22 you get a matt finished stand made of strong steel and fitted with rubber pads to prevent damage to polished surfaces. Optional extras include a multi-way power connector and a hinged bookstand. Contact Newscope Developments Ltd, 0373 864644.

Kuma kills bug

Two new programs for writing and debugging machine code programs on the Newbrain are out from Kuma, which is rapidly establishing itself as the number one Newbrain software house.

The Zen editor/assembler at £34 allows you to write and edit Z80 machine code programs, and is the most useful of the two programs, according to sales manager Jon Day.

N-Bug, a £28.25 monitor program/debugger, develops machine code programs and has full cursor control.

Its features include hex/decimal conversion, relative jump calculations, highlighting of specified byte sequences and the setting of break-points which allow controlled running of user programs.

A second display screen can be put in which gives menu selection of all tape and printer input/output functions. These include saving, verifying and loading of machine code routines and the facility to save a machine code loader on cassette for later loading and auto-running of debugged programs.

Kuma is on 0628 71778.

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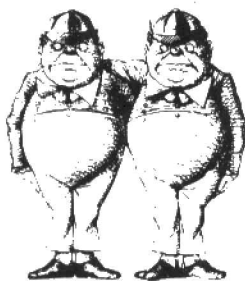
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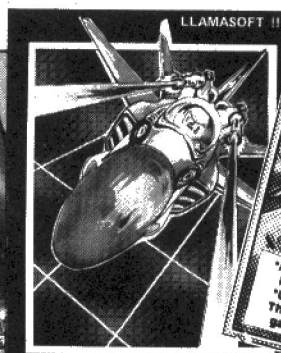
PCN Charts

You've followed the micro charts — now here's the games top 30 compiled from both independent and multiple sources across the nation. They reflect what's happening in high streets in the two weeks up to July 21 and, like the micro charts, do not take account of mail order sales. We'll be keeping them up to date, showing new positions every two weeks, so watch for the changing status of your favourite games.

The micro charts this week show the number of machines sold in the

GAMES

Top Thirty



Gridrunner

		GAME TITLE	PUBLISHER	MACHINE	PRICE
▲	1 (2)	Jet-Pac	Ultimate	Spectrum	£5.50
▲	2 (8)	Penetrator	Melbourne	Spectrum	£6.95
▲	3 (6)	Gridrunner	Llamasoft	Vic 20	£8.50
▼	4 (3)	Trader	Quicksilva	Spectrum	£9.95
▲	5 (7)	Transylvanian Tower	Shepherd	Spectrum	£6.50
▲	6 (11)	Ah Diddums	Imagine	Spectrum	£5.50
▼	7 (4)	The King	Microdeal	Dragon 32	£8.00
▼	8 (5)	Arcadia	Imagine	Spectrum	£5.50
▲	9 (13)	Killer Gorilla	Micropower	BBC	£7.99
▲	10 (—)	SS Enterprise	Silversoft	Spectrum	£6.00
▼	11 (1)	The Hobbit	Melbourne	Spectrum	£14.95
▲	12 (14)	Flight Simulation	Psion	Spectrum	£5.95
▲	13 (20)	Zaxxon	Datasoft	Atari	£29.90
▲	14 (18)	Black Hole	Quest	Spectrum	£6.00
▲	15 (21)	Timegate	Quicksilva	Spectrum	£6.95
►	16 (16)	Moon Raider	Micropower	BBC	£7.99
▲	17 (—)	Matrix	Llamasoft	CBM64	£8.50
▼	18 (15)	Miner 2049er	BigFive	Atari	£29.95
▲	19 (—)	Planetoid	Acornsoft	BBC	£9.95
▲	20 (24)	Everest	Shepherd	Spectrum	£6.50
▲	21 (28)	Psst	Ultimate	Spectrum	£5.50
▲	22 (30)	Knot in 3D	New Generation	Spectrum	£5.50
▲	23 (26)	3D Combat Zone	Artic	Spectrum	£4.95
▲	24 (25)	Xenon 1	IJK	Oric	£5.50
▼	25 (10)	Frenzy	Quicksilva	Spectrum	£4.95
▼	26 (12)	Krazy Kong	Interceptor	Vic 20	£6.00
▼	27 (9)	Horace Goes Skiing	Psion	Spectrum	£5.95
▼	28 (17)	Panic	BugByte	Vic 20	£7.00
▲	29 (—)	Preppie	Atari	Atari	£21.00
▲	30 (—)	Pakacuda	Rabbit	CBM64	£5.99

PCN Charts

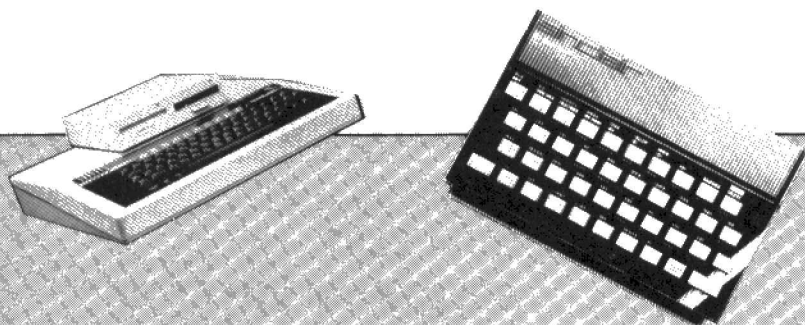
two-week period ending two weeks before publication date, so they tell the story in the high street between June 7 and July 21.

Neither mail order nor deposit-only orders are included and the prices quoted are for the no-frills models and include VAT. Information for the top-selling micros is culled from retailers and dealers throughout the country and, like the games, will be updated every alternate week. Watch the arrows to see how they're doing.

PCN Charts are compiled by MRIB (Computers), London, (01) 408 0250.

HARDWARE

Top Twenty up to £1,000



▲	1	(3)	BBC B	£399	(AC)
▼	2	(1)	Spectrum	£99	(SI)
▲	3	(4)	Vic 20	£150	(CO)
▼	4	(2)	Dragon 32	£175	(DR)
►	5	(5)	Atari 800	£300	(AT)
▲	6	(9)	Commodore 64	£229	(CO)
▼	7	(6)	ZX81	£40	(SI)
▼	8	(7)	Oric 1	£99	(OR)
▼	9	(8)	Atari 400	£150	(AT)
►	10	(10)	TI 99/4A	£150	(TI)
▲	11	(12)	Newbrain A	£228	(GR)
▼	12	(11)	Colour Genie	£168	(LO)
►	13	(13)	Lynx 48	£225	(CA)
▲	14	(17)	Epson HX20	£472	(EP)
▲	15	(18)	Tandy Colour	£240	(TA)
▲	16	(19)	Sharp PC1500	£169	(SH)
▼	17	(15)	Apple IIe	£969	(AP)
▲	18	(—)	Jupiter Ace	£90	(JU)
▼	19	(14)	Sharp MZ80A	£549	(SH)
▲	20	(—)	Acorn Atom	£174	(AC)

Top Ten over £1,000

►	1	(1)	Sirius 1	£2,754	(ACT)
►	2	(2)	IBM PC	£2,392	(IBM)
▲	3	(10)	Commodore 8096	£1,374	(CO)
▲	4	(5)	DEC Rainbow	£2,714	(DEC)
▲	5	(6)	Osborne 1	£1,581	(OS)
▲	6	(7)	HP86A	£1,541	(HP)
▼	7	(4)	Apple III	£2,780	(AP)
▼	8	(3)	Olivetti M20	£2,754	(OL)
▼	9	(8)	Epson QX10	£1,700	(EP)
▲	10	(—)	Sanyo MBC 2000	£2,242	(SA)

AC — Acorn Computers. ACT — ACT Apple Computers. AP — Apple. AT — Atari International. CA — Computers. CGL — Computer Games Ltd. CO — Commodore. DEC — Digital. DR — Dragon Data. EP — Epson. GR — Grundy Business. HP — Hewlett-Packard. IBM — IBM. IC — Icarus Computers. JU — Jupiter Cantab. LO — Lowe Electronics. LL — Lucas Logic. OL — Olivetti. OR — Oric. OS — Osborne Computers Corporation. SA — Sanyo. SH — Sharp. SI — Sinclair. SO — Sord. TA — Tandy. TI — Texas Instruments.

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WRITE TO: Random Access, *Personal Computer News*, VNU, Evelyn House, 62 Oxford Street, London W1A 2HG.

The magic camel killer

The trouble with games reviewers is the lack of time they seem to spend with the software they are reviewing, and reviews are, or could be, very useful for avoiding a lot of bug ridden rubbish on the market.

Take for example *Attack of the Mutant Camels*, reviewed in your magazine a few weeks ago. I have yet to see any review of this game which mentions the bug in which the camels can be destroyed without even hitting them! It is done by taking your ship to the very bottom of the screen and firing in line with the centre of a camel. Level 31 no longer seems impossible!

D Glancy,
Waterlooville, Hants

But is this cricket? — Ed

Taking the lid off BINs

Whenever I read a book on machine code the suggestion arises that in order to calculate memory addresses from binary one should use a calculator to multiply the msb by 256.

I used to keep a scrap pad for such calculations but found it inconvenient, because the need for such calculations arises so frequently, and each time it distracts from the program. I therefore wrote out a 256 times table giving the msb values for 1 to 255 × 256.

Since it can be of the utmost importance to ensure that the addresses are correct, I then checked my table, using a 48K Spectrum, with a brief program:

```
10 LET Y = 256
20 FOR n = 0 to 255: PRINT n * y
30 NEXT n
```

The program is easily converted for almost all other home computers.

However, I think it would be a very useful aid to your readers if you were to publish a similar table (pull out) in one of your

editions, preferably in two colours, with the left hand column 1-255 in say red and the second column (left hand × 256) in black. This would easily fit into one page.

J D Sparke,
Stockton on Tees, Cleveland.

Thanks for the suggestion — we'll look into it — Ed.

Law wanted for labels

Have you ever noticed how almost every software company seems to over-glorify the graphic capabilities of their games? Surely this should be reported to the Advertising Standards Authority. I wonder how many people have been misled by flashy labels, covering hopeless programs often recorded on low-grade cassettes guaranteed not to load until a perfect volume has been found.

There should be a law made forcing all software publishers to include a screen photograph on the cover. That would remove any doubts as to the quality of the graphics. On Sinclair machines, it would be easier still as the paper on the ZX printer is just the right size for a cassette label — this would be cheaper, give an extremely accurate screen dump and would attract the Sinclair owner with its familiar typestyle.

I hope this letter, and others which will be sure to follow it, will encourage software publishers to be more realistic about the presentation of their games.

Declan Kelly,
Rathcoole, Co Dublin, Eire

Oust Apple intellectuals

Being the proud owner of an Apple II, I was delighted when a couple of issues back, you announced a series on sound which was going to include . . . wait for it! the Apple. Yes, no misprint, the Apple.

At last I thought, unbelievable, I thought. Having waded through endless articles on word processors etc, we were finally getting down to something really meaningful like how to get your missiles to go zap, splat or kaboom!

At last I thought, PCN has suddenly realised that the Apple is a popular micro. At last I

thought, some fun! fun! fun!

Oh dear. Ever been totally disenchanted? I mean like totally choked off? We don't get fun (or anything else really), what we do get is a canned history of the Apple, a list of commercially available sound packages and someone telling us 'There can't be many micro users who aren't tiring of square waves and the limited resolution of frequency and amplitude.'

Gosh! What? I mean like HUH? I've got news for you pal, there can't be many micro users who even know what you're talking about with an article about as uninteresting as watching paint dry, much less care.

Fore heaven's sake wake up PCN. The 'explosion' (no pun) in micro sales is about as new as your magazine is and user knowledge is generally consistent with this fact.

If you don't want to alienate the majority of the more frivolous Apple users then the sooner you shape up the better.

RJ Davis
Deganwy, Gwynedd.

Like, hey man, this was really hot stuff. And I bet there's a bundle of Apple users who got a real buzz out of it.

But we do lots for the less technical too . . . like Lisa in issue 1, Ultimate II in issue 2, speech synthesiser in 3, Dark Crystal in 4 . . . Ed.

Atari angst after review

Shame on you PCN!!!

Of all the computer magazines, I thought you would be the last to start (dare I say it) ATARI BASHING!!!

How dare you!

First of all I will state my case. I am British and I buy British (when I can). But if buying British means buying a BBC Micro (as suggested) instead of an Atari then I definitely won't!

Why should I buy a machine that I don't like, a newcomer. It's not even a tried and tested machine (compared with the Atari).

In your review Atari vs Acorn (*PCN issue 16*) the BBC was made out to be a 'Wonder Machine', whereas the Atari was punched, beaten and kicked while it was down! Why did your reviewer continue to criti-



cise Atari for providing a great service to Atari owners (a box into which you plugged the bits you wanted!).

Surely Atari should be praised for this consideration, not condemned! As for the Basic, yes the Beeb's Basic is better and so it should be. Look how long they have had to develop it.

Where was the Beeb when the Ataris came out? Perhaps the Atari is old, but at least it can stand the pace of today's computer market and come out as one of the top micros. Also with the new Atari range the Beeb will be in the shade! Just imagine Ataris, Ataris everywhere, 400s, 800s, 1200s, 600XLs, 800XLs, 1400XLs and 1450XLs.

Match that, Acorn!

Plus, each of the new machines is compatible with existing software (how about that for service?).

So Atari owners, stand by your machines, you bought the best and you know it.

Nothing was said of the special chips inside the Atari which make it a powerful graphics machine, without gobbling vast amounts of memory (Acorn take note).

I'd like to tell your reviewer that there is a GET statement. He should read the manual, pages 28 and 49 — or is the American language so nauseating that he can't open the cover for fear of being savaged by 'American spellings'. Ah Did-dums!

The Atari manual is readable whereas the Beeb's effort reads like a cross between the Beano and War and Peace, firstly understandable and secondly thickness!

As for the Beeb's cursor, it is non-standard and awful to use (having to copy the whole line again with the COPY.)

Furthermore, why has Acorn left a large hole at the back of the Beeb?

At one primary school near me, the children (when they were bored with the 'Welcome' cassette) started poking pens, pencils, crayons and paper into the machine, onto the printed circuit board.

Isn't this highly dangerous?

A Newiss
Keighley,
W. Yorks.



ROUTINE INQUIRIES

Lost in a maze of bits and bytes, trapped in a forest of errors, or bugged by Basic? Whatever your problem, access our HELP function . . . better known as Max Phillips.

Write to: Max Phillips, Routine Inquiries, *Personal Computer News*, VNU, Evelyn House, 62 Oxford Street, London W1A 2HG.

Assemblers — the whole Spectrum

QI've just started to learn machine code on my ZX Spectrum and have armed myself with numerous assemblers and disassemblers. I've come across two problems.

How do I get a machine code program to write on the screen? For example, how could I write the following in assembler?

10 PRINT "Enter number"

20 INPUT A

30 PRINT "YOU
PRESSED";A

Second, could you print a complete list of Z80 mnemonics and what they do, or at least tell me where I could get one?

J Pateman,
Newton Aycliffe, Co Durham

AHow do you PRINT and INPUT from machine code? Not easily. There are no built in functions so it's up to you to write them. You just have to construct subroutines that do the jobs you need.

You can write a program to wait for a key to be pressed, then a routine that calls this to read in a whole line of text.

Similarly, you know where the screen memory is and how it is organised. So you can write a routine to print a character on the screen, then a routine to print a whole string of characters on the screen.

But it isn't impossible. A good example would be the routines already present in the Spectrum's ROM. If you grab hold of a book such as Dr Logan's Complete Spectrum ROM disassembly, you can even just use the routines already there.

Don't! Stay away from the Spectrum's ROM. Sinclair rightly warns against using it. The company may make changes that move things about.

Of course, having a look at what is there is tremendously useful. The routines in Sinclair Basic are an excellent example of how your own routines should look. Once you've written your set of Input/Output routines, you've finished. Just

include them in every program you write in machine code.

As for a list of Z80 mnemonics, you should have one. I can't believe that somewhere in the blurb for your numerous assemblers and disassemblers there isn't one. If there isn't, buy yourself an introductory text on Z80s. You'll discover all sorts of wonderful things.

A grand old tale of Ks

QWhy does 1K equal 1024 bits? Why isn't it simply 1000 bits?

Mohibul Islam,
Wendover, Buckinghamshire

ALet's try and avoid confusion here. Most of the time K means Kilo or 1000. You know Km for kilometres (like a mile but shorter) or Kg for kilograms and so on.

In computers, K means 1024. This is because computers work in binary (base 2) and 1000 is a 'silly' binary number. The nearest sensible binary number to decimal binary 1000 is 1000000000 which is 2^{10} or 1024 in decimal.

Now all we've got to decide is 1024 whats? Most of the time people use K to mean bytes . . . the 8-bit groups used to store data in a computer's memory. So when you use phrases like '16K RAM' or '24K ROM', chances are you are talking about kilobytes. Once upon a time, people even used to say Kbytes and write Kb.

The other use is when you are talking about the memory chips themselves. 'A 64K RAM chip' probably refers to a chip that can store 64K (that's 65536) bits. It would take eight such chips to give a machine 64K bytes of RAM. Confusing, isn't it?

If I were you, I'd avoid saying 1K = 1024 bits. Take 1K as being 1024 bytes and say '1K bits' if that's what you mean.

Atari assembler — an open book?

QI am an Atari 400 owner and have been programming in Basic for the last two years. I want to learn machine code and am thinking of buying the Atari assembler cartridge.

But I've heard that the manu-

al that comes with it does not teach a complete beginner machine code. Are there any books that do?

Declan O'Kane,
Culmore, Londonderry

AYou're lucky to have been warned. Many people aren't aware that assembly language tools usually have manuals that assume you know what you're doing. They just introduce the particular features of that package.

Of course, you can get introductory texts. This might be for a particular machine and package, just a particular machine or just a particular processor. In the Atari's case, the classic 6502 book is *Programming the 6502* by Rodney Zaks (Sybex). But remember this is a general text . . . you'll have to relate it to the Atari and its assembler cartridge yourself.

The other type of book that comes in handy is a 'peeled' book . . . one that gives you memory maps, register settings and so on. You'll need this so that the programs you write can take advantage of the Atari. You'll end up with a daunting heap (well . . . three) of books. Don't be put off. You don't need to read them through . . . just dip into them for whatever you need.

Is brass banned on micros?

QI am thinking of buying a computer, in particular I want to use it to make music.

I arrange music for a brass band for fun. This often entails writing a score for up to 20 different parts. Of course, I can't check all of those by playing them myself. I just have to hope I've got it right.

I believe it is possible to purchase a computer capable of playing a tune in three part harmony. But is there a computer capable of 20 parts?

Rodney Evans,
Colby, Isle of Man

ATwenty voices sounds like a rather tall order. Low-end machines have at best three voices (BBC, Oric, TI) or even four (for example, Atari) and many add-on extras don't give you many more. This is simply because the chippiness used to provide affordable sound just

isn't up to much more.

Probably the nearest you'll get is to stack up some of the available add-ons. Many of the sound cards available for the Apple can be used in pairs. Even so, 20 voices is probably over the top. And, unless you enjoy shocks, you will probably be advised not to ask about dedicated music synthesisers!

Within reasonable price bounds (you do arrange for fun), I think I'd leave brass bands in your capable hands. But don't skip the micro just because it can't play twenty instruments at once. You should be able to persuade it to help with fiddly bits such as transposing and working out harmonies.

Besides, you'll find programming a simple little synth like the BBC micro a challenging and enjoyable exercise.

Multiple micros problem

QI'm going to buy my first microcomputer in the Autumn. I have narrowed the field down to two computers — the Acorn Electron and the Memotech MTX500.

Could you give me your opinion of these two micros. Are there any similar micros due to be launched in the near future?

Mark Paton,
Marlow, Bucks

AThat's a very narrow field you've arrived at. Two computers that aren't ready yet! I know they are promised fairly soon but even when they appear you should be cautious about buying one.

The only predicting I'll do is that, yes, there will be similar micros launched in the future. Hundreds of them. The days when there were a recognisable number of breeds — Apples, Pets, Model 1s, Nascoms — are history. You won't find 'narrowing the field' such an easy task.

BEEP op a Lulu?

QI've just bought a copy of Jet-Pac from Ultimate. I noted a small paragraph deep within the weighty documentation (ahem!). It suggested that if you plug the mic wotsit from the

ROUTINE INQUIRIES

Spectrum into the mic wotsit on the tape recorder, you could amplify the sound through the recorder using the volume knob.

I'm shocked. Can all sound in all programs be amplified in this way? Or what little routine is used in Jet-Pac? Could you contrive to feed the sound through your Hi-Fi or speakers? Surely this makes all the various pieces of amplifier hardware redundant?

Philip South,
Hemel Hempstead, Herts

AIt's true, it's all true. But it isn't much of a secret—page 138 of the manual confesses all. Anyone trying to do it will find the fiddling easier if they open the cassette recorder, hold down the little lever in the back-left of the compartment and push PLAY and RE-CORD. Some fiddling with leads and MON switches may be necessary.

And there's no problem with going over the top and running it through your stereo or PA or whatever. But that doesn't make all the add-on sound hardware redundant. You'll notice that Spectrum sound is fairly crude. Many of the boxes let you do better things, though only in your own programs. And there are tape recorders which just won't co-operate.

Spectrum's wee entry problem

QI've had awful problems trying load 'Orbiter' from Silversoft into my 16K Spectrum. I've taken my tape back twice to WH Smiths and it has been replaced without question. The instructions say type CLEAR 25102? LOAD "" CODE. Can you help? the computer comes back with is CLEAR 25102? LOAD "" CODE. Can you help?

Julius Uzu,
Sheffield, South Yorks

AThis one's easy (you'll be kicking yourself). Just enter CLEAR 25102, then type LOAD "" CODE and press ENTER. Isn't it strange how the simplest little omission from the documentation can cause all sorts of problems? met by first timers with loading the Spectrum is omitting the CODE entirely or typing it out in letters. It is a keyword and should be entered by pressing Caps and Symbol-shift (cursor

becomes an E) then the I key. And remember to check that the tape runs on a 16K machine if you don't have the 48K.

All the same, such frustrations aren't all bad. Everybody (users and documenters) learns from them.

Setting up a micro venture

QI am thinking of starting a small business with one of my friends and was wondering about the various procedures I will have to go through. Do we need a licence or to register as a company or join any union? Is copyright essential? Can I use my house as a sales office?

How much does it cost to have programs duplicated using professional equipment?

Andrew Hawkins,
Skelmersdale, Lancs

AYou should be very careful about launching off into an unplanned venture. It could easily end in tears. So do as much homework as possible before you start... see your accountant and solicitor and, above all, make sure you've got a really good product.


To run quickly through your questions, there are no licences or unions to bother with (though there may soon be). It is in your own interests to become a registered company, but get your solicitor to explain how to start trading.

Copyright is essential... for your own sake. But if you have produced your own product, you have already got it. Make sure your customers know it. Using your home as business premises depends on your local authority. You may find that nobody minds you having a PO Box and running a mail order business, while opening a shop would be prevented.

Onto more serious matters. Program duplication costs less than you think.

You'll find the problem is that you will need to buy long runs... fifty cassettes is a generous minimum from some companies. But the real expense is the risk of duplicating thousands of a bugged program.

Don't go into this thing unless you are serious. In which case, take the time to plan properly. If you do have something to offer, the best of luck. But, if you've got the same old dream as hundreds of others, don't expect to make it last.



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BBC tapes verified

The BBC micro strangely doesn't have a verify command. You can do a reasonable simulation by setting up a function key like this:

*KEY 0 PRINT "VERIFYING": *LOAD "" 8000 [L] M

After saving, rewind the tape and press F0 to verify the tape. A faulty recording will produce error messages. If this happens, hit ESCAPE and try SAVEing again. You'll get a beep at the end of the process if the program is all right.

K Wolstenholme,
Deansgate, Manchester

Animated Sinclair

Many Spectrum games feature blobs moving around the screen without any real animation within themselves. It's like the way a dog walks compared to the way a Monopoly dog moves. If you don't understand the difference detailed animation makes, try this program.

But you'll discover that this sort of animation uses up a lot of user-defined graphics. Fortu-

nately, you can just page them. The Spectrum can handle up to 21 UDGs at a time. All you need to do is POKE the UDG pointer (in locations 23675 and 23676) to point to swop from one set of graphics to another. Provided you CLEAR enough memory, you can animate between three or four sets of graphics.

Julian Skidmore,
Trowell, Nottinghamshire

Unbreakable Atari

The Break key on the Atari can be disabled with two simple POKES. Try POKE 16,64 followed by POKE 53774,64. POKE these locations with 192 to get back to normal.

Craig Reading,
Runcorn, Cheshire

Jumping around the Oric

Locations #1B and #1C hold a useful vector on the Oric. It's the address that Basic jumps to after a program has been interrupted or an immediate instruction has been executed.

Normally, it is set to #CBED, but other addresses are possible. #FA85 will cause the Oric to PING whenever execution is finished. #EA59 is the Oric startup routine. Setting this will cause the Oric to clear its memory if CTRL-C or RESET are used.

To set the vector, just DOKE #1B, address.
Gordon R Love,
Hamilton, Lanarkshire

A colourful clearout

The Oric 1 uses PLOT to position messages anywhere on

```
10 PAPER 3: INK 2 : CLS
20 PLOT 2,10,"THIS IS A TEST LINE"
30 WAIT 100
40 PLOT 2,10,"NEXT LINE":WAIT 100
50 PLOT 2,10,"LAST"+CHR$(3): WAIT 100
60 PLOT 2,10,3
70 PLOT 2,20,"THE COW JUMPED OVER THE MOON"
80 WAIT 100: PLOT 21,20,3
90 WAIT 100: PLOT 16,20,3
100 WAIT 100: PLOT 9,20,3
```

Oric blackout — see A colourful clearout.

the screen. This just prints the characters in the message and therefore does not clear the rest of the line. SPC(n) can't be used in this way.

One neat dodge is to use an attribute that sets the foreground colour the same as the background colour. This hides any text remaining on that line. Try the accompanying program.

M Graven,
Sale, Cheshire

ZX81 partial to a scroll

ZX81 users will find location 16418 useful. Try PRINT AT 21,0; not more than 32 characters followed by POKE 16418,3. You can now scroll the screen without disturbing the line printed at 21,0.

POKE 16418,n puts 23-n lines on the screen. 23 is the maximum and you must have at least two lines (POKE 16418,21) on the screen before attempting any input. If you do use all 23 lines on the screen, you won't get a report code.

Simon Allen,
Birstall, Leicester

Orical text in high resolution

This short subroutine will be useful for Oric programmers. It allows text to be displayed in the HIRES mode at the cursor position.

```
1000 FOR I=1 TO LEN(SS$)
1010 CHAR ASC(MID$(SS$,I,1)),0,1
1020 CURMOV 7,0,3
1030 NEXT I
1040 RETURN
```

To call the subroutine, position the cursor, set SS\$ to the text to be printed and GOSUB 1000. Here's an example:

```
10 HIRES
20 CURSET 10,100,3
30 SS$ = "THIS IS A MES-
```

SAGE"

40 GOSUB 1000

50 END

David Jones,
Edmonton, London

Dragon colour trickery

The highest resolution on the Dragon normally only gives you two colours (black and white or black and green). However, a simple POKE provides a third colour. To get a 'light purple', enter PMODE 3,1: SCREEN 1,1: POKE 65314,248.

This line tells Basic that a four-colour mode is required while the video chip thinks that a two-colour high resolution mode is required. The new colour set has 0 = white, 1 = black and 2 = light purple.

Richard Chan,
Walton-on-Thames, Surrey

Repeating paradox

There is a simple way of speeding up either Oric Basic or the keyboard auto-repeat. Type POKE 775,10. The auto-repeat will be much faster but programs will run more slowly.

Alternatively, put a big number in 775 (for example, POKE 775,255) and the auto-repeat will switch off but programs will execute noticeably faster.

To get back to normal POKE 775,39.

Andrew Mellanby,
Aberdeen

Vic key control

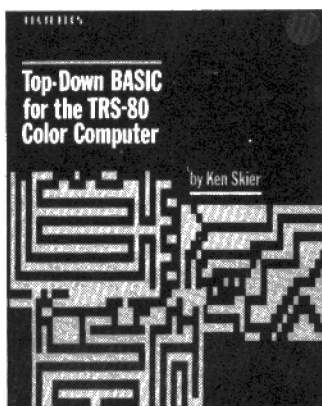
Owners of unexpanded Vic 20s can disable the RUN/STOP and RESTORE keys using POKE 37150, 3; POKE 788,194. The keys are restored with POKE 37150,130: POKE 788,191.

P O'Connell,
Whickham,
Newcastle-upon-Tyne.

```
10 FOR I=144 TO 150: FOR G=1 TO 7: READ A: POKE USR CHR$(I+G),A: NEXT G: NEXT I
20 REM character data
30 DATA 16,3,3,254,16,3,3
40 DATA 2,3,81N 110100,14,5,4,
50 DATA 3,3,3,3,128,3,3
60 DATA 3,4,2,1,2,4,5,32,54,12
70 DATA 3,3,3,3,3,3,3,128,3,81N 1011000,224,54,32,3
80 REM demo
90 FOR I=0 TO 29: PRINT AT 5,I: "X": AT 10,I: "graphicA": PAUSE 5: PRINT AT 10,I: "graphicB": PAUSE 5: PRINT AT 10,I: "graphicC": PAUSE 5: PRINT AT 10,I: "graphicD": PAUSE 5: NEXT I
```

Detailed character movement — see Animated Sinclair.

Which book would your micro want you to buy? PCN's review page helps you to choose.



'Top-Down Basic for the TRS-80 Color Computer' by Ken Skier, published by McGraw-Hill at £10.95 (paperback, 316 pages).

Any TRS 80 Color Computer owner who knows more about the computer than how to plug in a games cartridge should immediately put this book down on the shopping list.

It's not just another 'learn how to use Basic' effort, replicating the material in the user manual. Indeed, given the standard of Tandy documentation, it couldn't afford to be. Whatever might be said about Tandy hardware, most people would agree that the documentation provided, especially with the Color Computer, is among the best.

Top-Down starts where the Tandy documentation finishes. The object is to teach people how to conceive and structure their programs, rather than simply get them to the point where they survive trial and error. As the author says, a house may be composed of many small things — bricks, nails and so on — but an architect thinks in terms of the larger structural units such as the foundations, walls and roof. Only when the structure has been determined do you get down to nuts and bolts.

The same thing applies to programming, of course.

The style is less patronising than the Tandy Manual but retains the 'we'll all have fun learning how to program' feel.

The method is to work through a number of example programs, illustrating how you should plan the program using flow-charts and split the program into sub-routines. The programs become progressively more complicated.

The body of the book is split into two sections. The first is a series of programs for 4K or 16K Color Basic systems and

the second presents programs for 16K extended Color Basic systems. This book is very professional and well-thought-out. In fact, it might almost be worth buying a Tandy Color Computer just to use it. **IS**

'Computer Crunch' by Lew Hollerbach, published by John Wiley & Sons at £4.95 (hardback, 143 pages).

This is an extended checklist of things to do, know, remember and allow for if you plan to plunge into a computer purchase. As the title suggests, the author takes rather a cynical view of the business. For example, when you're analysing your needs, 'Don't talk to suppliers or salesmen yet, they will be a hindrance.'

It's very easy for authors to start waffling to fill space in books of this nature. This is not a problem here because the material is set out in point system.—

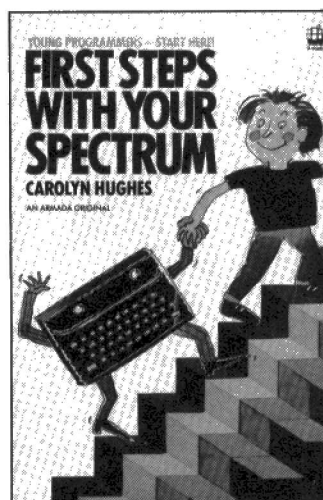
'There is only one reason for getting a computer:

● as an aid to professional expertise.'

Although a lot of games players would take issue with this statement, you can't fault it for directness. The whole book is written in this style and it actually makes quite compelling reading. The idea, I suppose, is to demystify the jargon and a step by step approach is the best way to accomplish this.

The last part of the book is devoted to a glossary of terms and a separate glossary of acronyms, plus an index. *Com-*

puter Crunch should make a painless introduction to computing for the non-digital. **IS**



'First Steps with your Spectrum' by Carolyn Hughes, published by Armada at £1.25 (paperback, 126 pages).

If you're under the age of about ten and find most of the books published to help Spectrum owners a little difficult to follow you may be interested in a new book which attempts to take the mystery out of computing by presenting computer ideas in a step-by-step way.

First Steps is easily affordable at £1.25 (a welcome change) and at this price you don't get any fancy colour or packaging. What you do get is a well-conceived series of chapters, illustrated with friendly line drawings and tons of handy listings and exercises.

It's no doubt difficult to know where patronising starts and taking nothing for granted finishes if you happen to be writing a book like this, but the thin line seems to have been well negotiated here.

The reader is shown how to set the Spectrum up, with diagrams of the cables and components. The computing ideas are illustrated both graphically and textually without appearing to question the IQ of the reader.

The only quibble I have is the token index at the back which has a mere 59 entries — most of them Basic words and symbols. **IS**

'25 Advanced Games for the Pet/CBM' by Larry Hatch, published by Prentice-Hall at £11 (paperback, 201 pages).

A bit of an oddity, this one. 'Advanced games' on the Pet seems to mean the kind of thing

that owners of other computers wouldn't normally spend five minutes with. The lack of decent graphics, sound and colour do not make Pet a natural choice as a games machine.

However, with one or two exceptions best glossed over, Larry Hatch has made the best of the limited facilities and come up with a collection of programs (better termed 'recreations') that are worth the effort of typing into your machine, especially considering the general lack of fun programs for this venerable beast.

There are a few games here that have been around longer than the Pet itself (just), ranging from noughts and crosses and its variants, to dice games and a fruit machine.

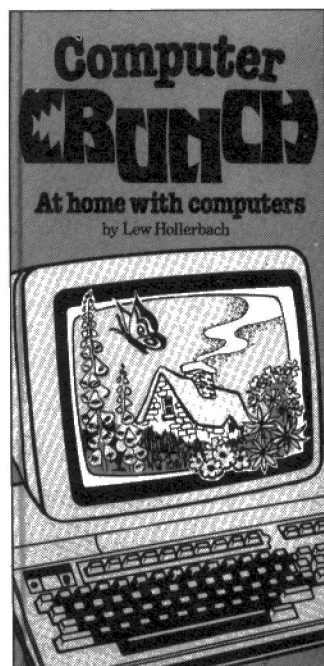


In the 'recreation' classification are a hex/decimal converter, prime number generator, and a palindrome writer (as in 'Madam, I'm Adam').

But the gems in the collection are those in which Mr Hatch makes the best of the Pet's block graphics and comes up with a few for the arcade addict. The best of these is a highly creditable version of Centipede and there are reasonable versions of Space Invaders and a 'submarine attack' program. There is also a remarkably good Rubik's Cube simulator.

All of the programs are accompanied by an introduction and an explanation of what the code is doing, and there are screen dumps of each program at various stages throughout the games.

My greatest reservation is the price, which strikes me as excessive for what is essentially a collection of computing anti-ques. **PW**



Get the most from your Genie's sound facilities with Keith Hook's machine code controller.

Mixing it with the Genie

Because of the lack of instructions and the non-arrival of the Technical Manual for the Colour Genie, a lot of people have found great difficulty in producing the sound effects they want with the SOUND instruction. To counter this I developed a small machine language routine to help me experiment.

Using the program

If you have an Editor/Assembler, type in the program as shown. The name is SOUND1 and execution is from 4900H, and located in the high resolution screen, so you do not need to save memory on power-up. For those people who do not possess an assembler, make a Basic program to POKE the values into memory, eg:

```
1 CLS: FOR I =&H4903 TO
&H4954:READ J:POKEI,J:NEXT
2 CALL4903
3 Data statements here starting @line7
(4903H address) CDC901)
Do not POKE the line concerned with LD
SP,7FEAH.
```

Once you have entered the program either by typing 'V' if you have assembled the listing, or by a CALL 4903 if you have poked the program into memory, you will be prompted to input a channel number (0-16) followed by a prompt to input a value for that channel (0-255). You can now start experimenting.

Initially you will need to activate channels 0:7:8:12:13. Once the above channels are activated you should hear some sort of sound from your speaker. By altering channels 0:12:13, a different sound will be audible.

Channels 8, 9, 10: Amplitude Control Channels

These channels govern the volume of the sound, depending on which bits are set to 1. The control of these channels is by five bits only (0-4). If bit4 is set to 1, then control is passed to the Envelope Generator which gives a variable level of sound with differing waveforms. If bit4 is 0, then control of volume is by the value given to these channels. All this means is: if you give a value between 1 and 15 then the level of sound is just the same as using these numbers in the Basic PLAY command. If you give a channel a value of 16 then the volume of that channel depends on what value is in channel 13.

Channels 0, 1, 2, 3, 4, 5: Tone Control Channels

Channels 0 and 1 control channel 8, channels 2 and 3 control channel 9,

channels 4 and 5 control channel 10. All the above channels control the pitch of the note produced by the Amplitude Control Channels. Each pair of channels use only 12 bits (bits 0-7 and bits 0-3). The lower channel of each pair (bits 0-7) governs the fine tune (ie just using the lower channel produces high pitched notes), and the higher numbered channel of each pair governs the coarse tune (low pitched notes). The combined values work just the same way as the note value does in the basic PLAY command.

Channel 6 Noise generator

Channel 6 acts like the above channels but this time on the white noise generator. This

channel only uses five bits (0-4), and the higher the value in this channel the lower the resultant frequency of the noise produced.

Channel 7 Mixer Control Channel

This is the most important channel to master, as this channel mixes the noise and tone for Channels 8, 9 and 10. To understand how channel 7 works take a look at table opposite (bottom right).

From studying the tables, it should be easy to work out your own values for other permutations. For example, try to work out: tone on channels 8 and 9 and noise on channel 10. You should come up with an answer of 92 or 28 decimal because bits 6 and 7 don't affect the noise and tone channels.

Channel 13 Envelope Generator

Channel 13 uses only four bits (0-3), and you should recall that if you put a value of 16 decimal in channels 8 or 9 or 10 then control of volume for that channel is passed to channel 13 and the resultant level depends on the value there.

The main values to try in this channel are

```
1          ;*****PROGRAM FOR TESTING SOUND
2          ;COMMAND WITH USERS VALUES *****
3          ORG 4900H
4          EXEC 4900H
5          LD SP,7FEAH ;GET STACK OUT OF WAY
6
7          CALL 01C9H ; CLEAR SCREEN
8          LD HL,409CH ; SET DEVICE TYPE FLAG
9          LD (HL),00H ; 00H FOR VIDEO DISPLAY
10         START:CALL 01C9H ; LOOP STARTS HERE
11         LD HL,MESS1 ; GET FIRST MESSAGE
12
13         CALL 28A7H ; ROM CALL OUTPUT MESS1
14         CALL 0361H ; ROM CALL $ INPUT
15         RST 10H ; MOVE PAST BLANKS GET
16         ;FIRST CHARACTER FROM INPUT
17         CALL 2B1CH ; CONVERT TO HEX
18         ;AND PUT IT IN A REGISTER
19         CP 10H ; COMPARE WITH 16
20         JP NC,START ; IF>16 THEN ERROR
21         ; GO BACK TO START
22         PUSH AF ; SAVE INPUT
23         LD HL,MESS2 ; GET MESSAGE 2
24         CALL 28A7H
25         CALL 0361H
26
27         RST 10H
28         CALL 2B1CH
29         LD E,A ; PUT THIS VALUE IN E REG
30         ; READY FOR ROM CALL
31         POP AF ; BRING BACK FIRST INPUT
32         CALL 3E32H ; SOUND ROM CALL
33         JP START ; GO BACK FOR ANOTHER GO
34         MESS2:DEFM "INPUT CHANNEL ?"
35
36         DEFB 0
37         MESS2:DEFM "INPUT VALUE ?"
38
39         DEFB 0
40         BUFF:DEFB 00H
41         END
42
43         Exec Addr 4900
```

0, 8, 9, 10, 11, 12, 13, 14, 15. These values will give you an assortment of waveforms from a single sound, to a rising, continuous sound.

Channels 11 and 12 Envelope Period

Combined, these two channels use two bytes (16 bits). Channel 12 controls the fine tune (high pitches), and channel 11 the coarse tune (low pitches).

Try different values in channel 12, and see what happens. Now put a value in channel 1 . . . you should hear the tone drop. Place a value in channel 11 and see how the envelope period changes, but remember channel 11 is only working because you place a value in channel 1 (coarse tune).

Make a note of any unusual sounds, then you can try them under Basic. Most sounds will need some kind of FOR . . . NEXT loop to get the best from them, but the fun is in the experimenting.

Try this Basic Program:

```
1 SOUND7,28
2 SOUND10,16:SOUND6,255
3 SOUND13,8:SOUND12,20
4 FOR I=0 TO 255:SOUND6,I:NEXT
5 GOTO 4
```



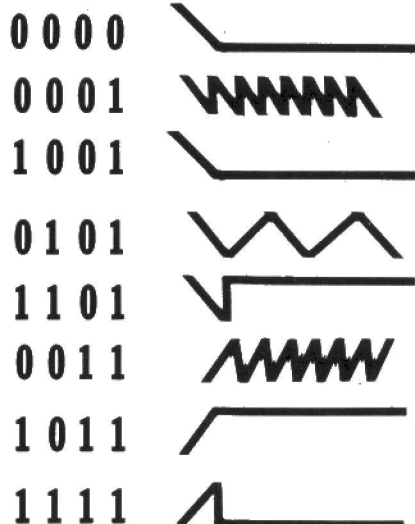
Sound on the Colour Genie: these tables demonstrate how different values produce different effects.

Right: The possible values for Channel 13 (the envelope generator) and the resulting sound envelopes.

Below: Sample values for Channel 7, the mixer control channel.

Bottom: More detailed values for Channel 7. At left the higher bits control the noise while the lower bits (right) control the tones.

BITS 0 1 2 3 WAVEFORM



Dec Value	Bits 7 6 5 4 3 2 1 0
254	1 1 1 1 1 1 1 0 Turns tone on 8 all others off.
253	1 1 1 1 1 1 0 1 Turns tone on 9 all others off.
7	0 0 0 0 0 1 1 1 Noise only on all 3 channels.

BITS 5 4 3	NOISE REMARKS	BITS 2 1 0	TONE REMARKS
0 0 0	Noise on channels 8 9 10	0 0 0	Tone of channels 8 9 10
0 0 1	Noise on channels — 9 10	0 0 1	Tone of channels — 9 10
0 1 0	Noise on channels 8 — 10	0 1 0	Tone of channels 8 — 10
0 1 1	Noise on channel — — 10	0 1 1	Tone of channel — — 10
1 0 0	Noise on channels 8 9 —	1 0 0	Tone of channels 8 9 —
1 0 1	Noise on channel — 9 —	1 0 1	Tone of channel — 9 —
1 1 0	Noise on channel 8 — —	1 1 0	Tone of channel 8 — —
1 1 1	All noise channels off.	1 1 1	All tone channels off.

Welcome to the machine . . . Brian Cadge presents some speedy utilities for your Dragon 32.

The Dragon computer has an excellent cassette operating system which can handle serial files, Basic and machine language programs, ASCII format programs as well as verify recordings. But there is one useful capability which is not built in — autorunning a program on loading. There is no LOADGO or similar command and some program lines do not work as on some other computers.

For example: 100 CSAVE "PROG":
RUN.

The utility program we will present next week gives you the facility to have programs autorun when loaded, and also allows you to design and edit a title page which will be displayed while the program is loading. The program produces a small machine code program which is saved just before the program you wish to autorun. Let's start off with an explanation of how to use the program once entered.

All the control keys, CLEAR, BREAK, ENTER, etc have new uses. When starting you will see a flashing cursor on the screen, you can move this around using the four arrow keys. The cursor is non-destructive and so can move over text already on the screen without disturbing it. Pressing any normal key produces the character at the cursor position. You can use SHIFT 0 as usual to move in and out of reverse video text.

Possible shapes

No doubt, you will wish to use colour graphics on the title screen. By pressing SHIFT UPARROW you toggle between text and graphics mode. If you look at page 138 of the Dragon manual you will see illustrations of various possible shapes. In pencil, write next to each the hexadecimal number from 0 to F. That is, put a 0 by CHR\$(128), a 1 by CHR\$(129) up to a 9 by CHR\$(137), then an A by CHR\$(138) up to an F by CHR\$(143).

In the graphic mode, pressing the letter or digit that corresponds to the correct graphic shape will produce that shape in green. To change the colour to any one of the eight available, press the ENTER key. You will hear a beep, and the cursor will disappear. The program then waits until a key from 1 to 8 is pressed.

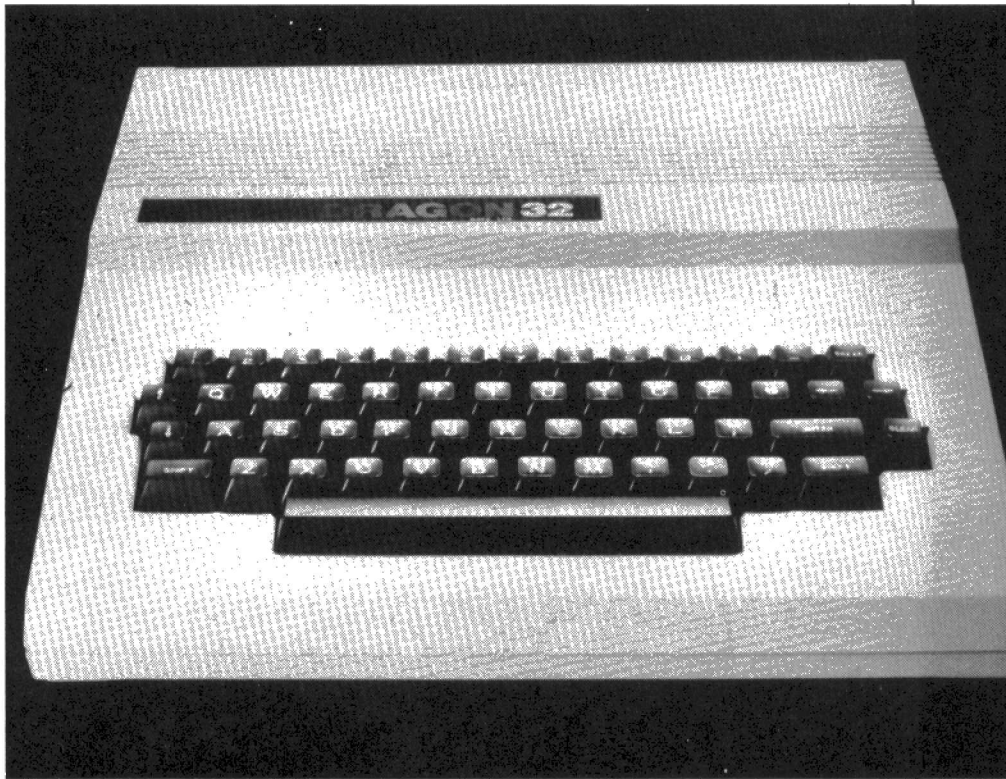
The number corresponds to the colours listed below:

- 1 — GREEN
- 2 — YELLOW
- 3 — BLUE
- 4 — RED
- 5 — WHITE
- 6 — CYAN
- 7 — PURPLE
- 8 — ORANGE

Pressing the CLEAR key will clear the whole screen to the present colour. The position of the cursor remains unchanged, but all text and graphics are lost. The SHIFT @ combination will return to Basic, use this after saving your screen design as Basic will overwrite the screen.

To save the design, set up a tape as if to

Paint your Dragon



Take one Dragon, add next week's listing, and have fun.

save a normal program, and press the BREAK key. The master program then copies part of itself into the RAM just before the screen memory and saves this and your design on the tape as a machine code program. The actual program which is to be autorun, whether it's Basic or machine code, is then saved on the tape. Note that to load an autorun program, use CLOADM to load the screen and header whether the actual program to be run is machine code or not.

If you use CLOAD you will get a file mode error.

To enter the master program into your Dragon, either type in the assembly language listing directly if you have an assembler package, or use the Basic loader program listed — taking care with the data statements. This program will check for errors and will not run if any are found. Save the program before running it.

The program is started with EXEC 32000.

Next week we'll give you the machine code listing to accomplish this task. The program will come in two parts: a Basic loader program and then a machine code listing.

But be prepared to do a lot of typing, this is a long program.

Next week's program marks one of the longest in a series of programs we've been running for this machine. Two weeks ago, we featured a number of programs and routines to help you achieve scrolling effects on the Dragon within your programs.

We've also featured the Dragon quite prominently in our recent Sound Micropaedia series, and before that in the Graphics Micropaedia.

The Dragon is also featured quite regularly in the Program Cards section of PCN, with more programs to type into your Welsh micro.

Tandy in tandem

It's easy to forget, as well, that most Dragon programs will work with little or no modifications on the Tandy colour computer, as the processors of the two machines are the same and the Basics almost identical.

However, programs loaded on the Dragon won't necessarily load onto the Tandy due to a built-in tape-reading incompatibility between the two machines in order to convince people that they're not (quite) identical.

See PCN Issue 13 for help on how to overcome this incompatibility.

Forth is becoming more accessible to Spectrum-owners. Ted Ball weighs up two new packages.

Flocks of Forth

Forth is certainly multiplying on the ZX Spectrum — there's Abersoft Forth, which was reviewed in *PCN issue 13*, Artic Forth, and Mike Hampson's Floating Point Forth, being reviewed now, and two that we've not seen — an earlier integer-only Forth from Mike Hampson, and a version from CP Software.

There are many reasons for Forth being so popular. It comes between Basic and machine code in speed, ease of use, and the control you get over the computer, and a Forth interpreter is relatively small and easy to implement, whether it is based on the assembler listings published by the Forth Interest Group or written from scratch.

Abersoft Forth and Artic Forth are directly comparable, both being based on the FIG standard and having almost identical extensions to allow you to use the special hardware features of the Spectrum.

Mike Hampson's FP50 is quite different. It is written in Basic with some machine code subroutines, and is described as 'being based on, but not being, a Forth-79 standard'.

Artic Forth

Artic Forth appears to be an implementation of FIG Forth, with some minor modifications, and some extensions to handle graphics, colour, etc, on the Spectrum. The extensions largely use the same words as Spectrum Basic — PLOT, CIRCLE, INK, etc — but there are some differences, like GOVER instead of OVER because OVER is already used in Forth with a different meaning.

Two words from 8080 FIG Forth, P@ and P!, equivalent to IN and OUT in Spectrum Basic, are omitted, so you will have to add your own versions in machine code if you want to use Artic Forth with I/O mapped ports.

For saving your own programs on tape Artic FORTH has the standard FIG method of 'screens', a screen being a 1K block of memory arranged as 16 lines of 64 characters. Although this is not really suitable for the Spectrum's 22 lines of 32 characters it does allow you to type in published program listings without having to make any changes.

Unfortunately, you are allowed only one screen in memory at a time, which makes it awkward to save and load programs that extend beyond this.

To enter programs into a screen you have to use the editor which is on the tape immediately following the Forth code. As the editor takes up three screens you immediately get to see how awkward it can

be to load programs. You have to stop the tape after each screen has been loaded, wait a few seconds for a prompt, then press ENTER and start the tape again. As there is very little space between the screens you have to be very quick in stopping the tape before the next screen comes up.

The editor is fairly easy to use for entering programs into a screen, but making corrections is a lot harder. However, Artic has provided an additional 'on-screen' editor which allows you to use the arrow keys to move the cursor around and the EDIT key to copy text from the cursor position onto a new line.

Presentation

Artic Forth is attractively packaged in a box containing two printed manuals and a cassette which has the Forth and editor on both sides.

The 44-page User's Manual includes instructions for loading the tape, a brief introduction to Forth, and a glossary giving precise definitions of all the words in Artic Forth. The introduction to Forth will help you get started, but to learn the language properly you will need a textbook.

The four-page Editor's Manual contains only some brief notes on using the editor, and the editor glossary.

Reliability

Artic Forth is generally quite robust, but there are a few minor bugs.

If you press BREAK while the ZX Printer is running subsequent output goes to the printer only and the command to switch output back to the screen does not work. The only way I found of getting back to normal from this situation was to type COLD or WARM.

The Forth word FENCE is not implemented properly. This is meant to set a limit below which FORGET will not work, but whatever value you put into FENCE you can FORGET anything in the dictionary.

There is also an oddity in the on-screen editor. If you press DELETE at the beginning of a line you get a question mark. Pressing DELETE again gives another question mark instead of deleting the first one. However, this does no damage and you can escape by pressing ENTER.

Verdict

Although there is nothing important wrong with Artic Forth it is just not as good as Abersoft's version at the same price. Artic's documentation is a little better than Abersoft's, and the Artic on-screen editor is easier to use for making corrections, but Abersoft Forth has no known bugs, gives you more Forth words, and because it allows 12 screens in memory at once it is easier to load and save programs.

FP50 Forth

Although FP50 is claimed to be based on Forth 79, and the Forth words included in the dictionary are closer to Forth 79 than to FIG Forth, the differences are so great that you have to forget the standard when using FP50.

FP50 allows you to use integers in the range 0 to 65535 (instead of the standard -32767 to +32760) and floating point numbers in the range $\pm 1E38$, but not the double integers of standard Forth.

Many of the words in the dictionary come in pairs, one word for floating point operations and the other (preceded by %) for integer operations. For example + and %+, DO and %DO, etc.

This is the opposite to standard Forth where you have + for 16-bit integer addition, D+ for 32-bit integer addition and, if you have a floating point package, F+ for floating point addition.

Colon definitions for extending the dictionary and immediate commands are allowed, but there are some differences here. When you have typed in a colon definition and pressed ENTER, the name of the new word and its compilation address are printed at the top of the screen, and then the words making up the definition are printed one at a time as they are compiled. If you have included a word that is not in the dictionary you get a message 'XXXX not known. Continue definition' and you can carry on from the point you made the mistake.

Unlike normal FORTH you cannot add a new word to the dictionary if there is already a word with the same name.

There are two types of immediate command. The normal type consists of a string of Forth words which are executed as soon as you press ENTER, but in FP50 you have to end with a semi-colon, and before the command is executed you get a message 'compiling — please wait'.

The other type of immediate command includes things like PRON and PROFF for printer on and printer off, S for save, etc. These can be used only from command mode and cannot be used in colon definitions.

FP50 includes special commands for things like colour and graphics on the Spectrum, largely using the same words as Spectrum Basic. User-defined graphics are available, but with an 'immediate only' command, so you cannot easily change character definitions within a program.

The only way to enter a program is to type in the colon definitions one after the other. There is no way to alter a definition after it has been entered in the dictionary except by 'forgetting' the word (and everything typed in afterwards) and start-



Geoff Fisher

ing again. To save a program you have to save the whole of FP50 with your program added to the dictionary.

Presentation

The instructions consist of a 12-page A4 manual offset from a typed original. The manual is organised in tutorial form, taking you through the use of the FP50 program, and explaining Forth and the words in the FP50 dictionary. There is no index or glossary, and to find the definition of a particular word you have to go through the whole manual.

In use

FP50 can be quite tedious to use, with all commands and definitions being repeated by the compiler before anything is done with them.

The manual includes a table giving some comparisons between the speed of Basic, FP50 floating point, and FP50 integer calculations, but although I managed to get times for the integer calculations roughly agreeing with the table, I could not agree with the times for the floating point calculations.

Reliability

FP50 works correctly on most things, but you can get the wrong output in some cases. For example using % (integer PRINT) instead of . (floating point PRINT) will give the wrong answer. You also find that illegal calculations like 1 divided by 0, or giving the wrong input when defining user-defined graphics will drop you into Basic. The manual does, however, give warnings and tells you how to get back into FP50.

Where FP50 finds errors for itself it gives

helpful error messages and allows you to continue from the point where the error occurred.

Verdict

The main thing wrong with FP50 is that it does not follow any standard closely enough to be useful. The advantage of standards in programming languages is to make programs portable.

There is an enormous amount of useful software available in source form in FIG Forth and Forth 79, but you will find it very difficult to convert to work on FP50.

RATING	
Features	■ ■ ■ ■ ■ ■ ■ ■
Documentation	■ ■ ■ ■ ■ ■ ■ ■
Performance	■ ■ ■ ■ ■ ■ ■ ■
Usability	■ ■ ■ ■ ■ ■ ■ ■
Reliability	■ ■ ■ ■ ■ ■ ■ ■
Overall value	■ ■ ■ ■ ■ ■ ■ ■

Name Artic Forth **Application** Programming language **System** 48K ZX Spectrum **Price** £14.95 **Publisher** Sinclair Research **Format** Cassette **Language** Machine code **Outlets** Mail order

RATING	
Features	■ ■ ■ ■ ■ ■ ■ ■
Documentation	■ ■ ■ ■ ■ ■ ■ ■
Performance	■ ■ ■ ■ ■ ■ ■ ■
Usability	■ ■ ■ ■ ■ ■ ■ ■
Reliability	■ ■ ■ ■ ■ ■ ■ ■
Overall value	■ ■ ■ ■ ■ ■ ■ ■

Name FP50 Forth **Application** Programming language **System** 48K Spectrum **Price** £14.95 **Publisher** Mike Hampson, 7 Hereford Drive, Clitheroe, Lancs **Format** Cassette **Language** Basic & M/C **Outlets** Mail order

Ted Ball screen tests Easy Graphics, bypassing the number-crunching demanded by BBC Basic.

Look — no program!

The BBC microcomputer can produce excellent graphics, but the graphics commands in BBC Basic are rather difficult to use. This is because there are only a few words like DRAW and PLOT which have to be followed by lists of numbers to produce the graphics effects. Easy Graphics allows you to draw straight onto the screen and save what you have drawn, without having to write a program.

Features

With Easy Graphics it is possible to draw lines, circles, ellipses and polygons by using the arrow keys which move the cursor around the screen and by typing in a few numbers to specify the size and shape of the figures required. The most powerful feature is the repeat function allowing you to repeat part of your drawing, systematically varying the position according to a mathematical formula. This is particularly useful for drawing graphs and repetitive patterns. It can also be used for producing three-dimensional effects.

Another useful feature for producing perspective drawings is the 'rubber-band' function. This allows you to fix one end of a line while moving the other end. You can have several 'rubber bands' joined together in a network, all moving and stretching as you move the cursor.

It is possible to use all the colours and graphics modes available on the BBC micro, changing the colours at any time. Text can be included in the pictures for captions and labels. Easy Graphics uses the same 'actual' and 'logical' colours described in the BBC User Guide, so you will need to understand these to use colour.

To help with planning a picture you find the co-ordinates of the cursor and the distance between two points, and put a rectangular grid of any size over the screen.

The details of your drawing are stored in an array, and you can alter and delete part of the drawing by altering this.

Once your drawing is complete it is possible to save it on tape, and with a separate program called Redraw you can load and recreate the picture at any time.

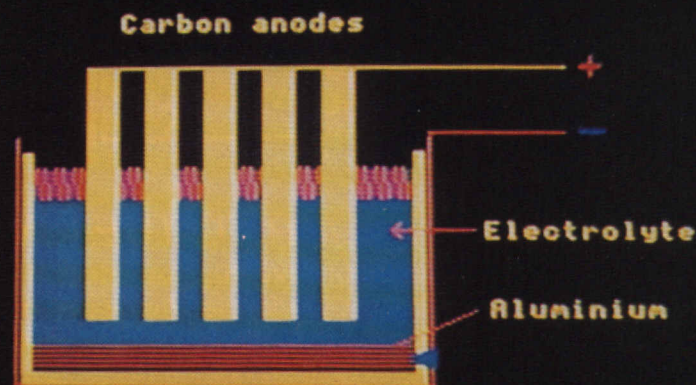
Presentation

The cassette is clearly labelled, and has the Easy Graphics and Redraw programs on one side. On the other side is a demonstration program that displays some impressive pictures produced with Easy Graphics.

The instructions are in a neatly printed 12-page booklet. All the features of the program are explained with examples for you to type in so you can familiarise yourself with the way the program works. There is also a table giving a summary of all the commands.

Easy Graphics uses all the user definable

THE EXTRACTION OF ALUMINIUM



function keys. There is a strip of card printed with the functions of these keys that you can slip under the plastic overlay.

In use

Although the examples in the instruction booklet help you to get started it takes practise to get used to all the commands. The function keys can be labelled with the strip provided. It is easy to remember the functions of most of the letter keys, such as D for measure distance and L for draw line, but some of the commands like control A to change graphics mode are not obvious.

Some commands, repeat, circle, etc, give you a list of prompts for the parameters they need. The prompts are mostly self-explanatory, however, some are rather odd, like TRIAL (10) which asks

whether or not you wish to save what you are doing in the array. It expects you to reply with either RETURN or 10.

Reliability

Although there is error trapping in Easy Graphics the instructions warn you that stupid inputs can make the program behave unpredictably, giving the lack of memory as an excuse for not making the program completely foolproof. You need to be very careful when using the program as errors in the input can make it crash. The 'Break' key is set up to wipe out the program completely.

Verdict

Easy Graphics is not all that easy, but it is much better than writing a Basic program. Although Hexagon Software's copyright says that displays produced with the program may not be included in your own programs, you can use it to try out various effects and then write your own Basic to produce the same effect. Or you can use it to produce graphic displays that are going to be shown by themselves.

It does seem rather expensive at £13.50, particularly as the limited error checking and built-in protection against listing the program has the side effect of making it very easy to lose a display.

RATING

Features
Documentation
Performance
User interface
Reliability
Overall value



Name Easy Graphics **Price** £13.50 **Publisher** Hexagon Software, 17 Straights Road, Gornal, Dudley, West Midlands DY3 2UR
Application Graphics design **System** BBC Model B **Format** Cassette **Language** Basic **Outlets** Mail order



Not the new Lennon and McCartney: Bob Chappell on the 64 and Max Phillips on the BBC Micro.

BBC silicon orchestra

Time was when nothing was more important than buying that first guitar. But if you blew your pennies on a BBC micro and not a flash red Strat copy, don't worry. Beebsynth from Clares could be what you need.

Features

Beebsynth holds no surprises... its features are adequate but not spectacular. Like many of its rivals, it divides into two bits. An envelope definer lets you design your own sounds, either for use in the synthesiser or in your own programs. And there's a synth function that lets you play tunes (and cacophonies) on the BBC's qwerty keyboard.

There are obvious reservations about any synthesiser without a piano keyboard. The first company to produce the program plus a plug in keyboard (no matter how nasty) plus a jumper to take the sound to an amplifier will go straight to number one in this market.

Beebsynth also fails to exploit the computer bit of the BBC — rhythm generation, tune storage, automatic chord generation and so on.

You've got a fair chunk of unused computing power lying around, but Beebsynth isn't the only package committing this offence.

In use

Beebsynth is fabulous to play with. These packages are often just a fiddly mess of

keys that give you two minutes' novelty noise and then take up shelf space. I can't say Beebsynth is beautifully logical but it is playable.

Starting with the Envelope definer, you get 14 boxes each representing one of the envelope's settings plus a box each for pitch and duration. You move from box to box with the left and right arrows and adjust their contents with the up and down arrows. A neat but tiresome technique.

Pressing Return steps you through a tiny helpscreen while the space bar tries out the current sound. Pressing K (and it must be capital K) takes you onto the synthesiser. You can save all 16 finished envelopes, but it is hard to reload 1 to 12 for use in the synthesiser.

The definer works well, but it isn't as straightforward to use as it could be. Why all these nasty numbers? There should be a graphics display with more help, better editing and so on.

But it does come with a handful of fabulous freaky sounds — no normal things mind you. It would be nice to find strings and horns as well as frog-squelch and Electric Dalek II. But the definer does make life easier. It takes hours of pen and paper work to make the same ghastly noises from Basic.

The synthesiser bit is based on a nearly two-octave keyboard, stretching piano fashion from CTRL to Return.

First clever feature is EFF 0 to EFF 2. Hitting the appropriate function keys

switches between three different methods of keyboard scanning. It doesn't make up for the lack of a real keyboard but it does help. F3 cuts the current sound, but it locks in position so you need to hit it twice sharply to chop a note off in mid-funk.

This is a great help. You can tune the Beeb into other instruments and set the range you're playing in. And with some envelopes, it lets you do some great glissando effects. To switch envelopes, you press Space followed by F0 to F9 or Shift-F0 to F6 and Return.

Verdict

Beebsynth is an excellent example of its genre. It doesn't go as far as BBC micro music could — you'd be advised to get extra hardware if you're serious about this. But it does provide a playable and enjoyable instrument. I could give up programming and go solo on this keyboard any day of the week.

RATING

Features
Documentation
Performance
Useability
Reliability
Overall value



Name Beebsynth System BBC micro 1.2 MOS
Price £7.95 cassette, £10.95 disk Publisher Clares,
222 Townfields Rd, Winsford, Cheshire Format
Cassette or disk Outlets Mail order

Opus on the 64

The good news is that the Commodore 64 has incredible sound capabilities. The bad news is that you can only use them by tortuous combinations of PEEK and POKE. The best news is that there is now a program, Synth-64, which changes all this.

Features

As well as giving you the ability to compose and edit melodies and harmonies using up to three voices, the program has commands for controlling the more complex capabilities of the 64's Sound Interface Device (SID) chip. Tonal quality (Triangle, Sawtooth, Pulse) for each voice can be switched on at the same time and mixed. The ADSR (Attack, Decay, Sustain, Release) of a sound can be controlled.

Synth-64 has five embedded instrument routines: piano, flute, trumpet, banjo and accordion, but inventing new ones is possible and fun.

In use

Compositions are built up in the same way as a Basic program. Each line of music has an identifying number followed by a series of commands and notes. These are translated when the piece is run. Changes can be made simply by using the 64's editor. A note is represented by a letter plus modifying characters. Such modifications include a number for the octave and /n for a quarter note, half note, etc, where n represents the fraction. Notes without modifiers take on the attributes of the last modified note. Sharps, flats, tied, dotted or triplet notes, rests, key signature, tempo and volume can all be specified.

Up to three voices can be selected for simultaneous use to create impressive harmonies. Synth-64 handles harmony by looking ahead and, if required, commencing to play the next note before the previous note has finished.

GOSUB commands play a subsection of music before continuing from the point immediately following the command.

Other commands allow the display of text while the music plays, loading and playing a composition from tape or disk, annotating and pausing. A trace facility can show the voice or note being played, but it slows everything down to such a

degree that the sound becomes considerably distorted.

A number of commands are available for use in direct mode: LIST, LOAD, SAVE and RUN (a composition) operate like their BASIC counterparts.

Verdict

The package is fairly simple to use, even if you're not very musical. Commands are short and easily memorised. This is an excellent program which considerably eases the complexity of using the Commodore 64's music facilities. The use of a Basic-like structure is a big help and I feel that this package is good value for money.

RATING

Features
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Useability
Reliability
Overall value



Name Synth-64 System Commodore 64 Price
£8.95 cassette (£10.45 on disk) Publisher Abacus
Software, PO Box 721, Grand Rapids, MI,
USA. Format Tape or disk Language Machine
code Other versions None Outlets Adamssoft, 18
Norwich Avenue, Rochdale, Lancs OL11 5JZ

Drawing on all his plotting expertise, Karl Dallas moves gracefully into the Pixy 3's circles.

Pixy penmanship at a pleasing price

Plotterers are those fascinating gadgets you'll find in at least one obscure corner of most computer exhibitions, clicking away as a series of pens draw complex diagrams in multi-colours. Usually, you'll get very little change out of £1,500 if you decide to buy one, and a really sophisticated multi-pen version will cost more than double that. This has previously ruled them out for all but professional draughtsmen.

But they can translate the quanta of computer output to smooth continuous movements, making real circles possible, and are much better at plotting things like pie charts than, say, a dot matrix printer. And the multi-pen capacity makes multi-colour plotting possible.

The basic difference between a printer and a plotter is that the latter actually draws everything, including alphanumeric output. Anyone familiar with the clever little printer available for Sharp's PC-1500 pocket computer, now fitted to the 700 machine in a slightly larger size, will be aware that it is actually a four-pen plotter. However, it uses paper only 2½in wide.

But now an American-designed, Japanese-made multi-pen plotter using full-size A4 paper has come on the British market for less than £600 (plus VAT), together with some very comprehensive software for exploiting its capabilities to the full. The Pixy 3 colour plotter is about the size of a really small desktop copier, in a white matt plastic case.

Features

Its on/off switch, plus accompanying LED, is at the top right-hand corner. There are three pen storage slots along the left edge, in which the pens are held, by magnet. A vertical plotting bar, able to slide horizontally across the top, holds another pen. The unit comes with five pens, two green, one red, one blue and one black. Three pens can be in use at any one time: two in the storage slots (leaving one vacant), and one in the plotting bar. If all three storage slots are filled, then the plotting bar has nowhere to deposit a pen after use, during the very neat pen transfer procedure, which can be software controlled.

In practice, it is quite easy to substitute fourth or fifth colour pens in the slots during plotting, so that as long as you remember that slot 2, say, was red at one stage, and blue at another, its colour capacity can be almost limitless. As the pens are magnetic there is a printed warning about putting any of them down on any data disks.

The plotting area has room for a single A4 sheet (placed sideways), which is held in place by two quite powerful magnetic rubberised strips. At the bottom right-hand corner is a touch-sensitive key pad. With this, it is possible to move the pen manually, with the pen raised, allowing a different start position from the normal 'home' (bottom left-hand corner) where the pen locates itself on initialising the plotter. It can also be moved with the pen down, producing results not unlike the old Etch-a-Sketch.

The test machine came with a copy of West Coast Consultants' 'Curve II' suite of programs on disk, together with a data disk of demo specimen plot files. This suite will cost a 'nominal' £50 extra, but it's almost essential.

Colour plotting costs have been cut by the Pixy

The 48-page hardware manual gives full details of the 20 commands, including DRAW (straight line), CURVE, CIRCLE, RELATIVE CIRCLE, ALTER-NATE (for Greek scientific notation), HOME and so on, but it's rather technical, and no program examples are given.

Curve II works very well. We'd been told it was entirely menu-driven, which is true, but because the programs are rather heavy on memory use, the menus aren't entirely self-explanatory. When letter size is requested, for instance, no available parameters are given. Since the pens are quite thick, and the minimum letter size of 0.7mm x 0.4mm is smaller than the pen-width supplied, a size of, say, '1' will give you unreadable text.

The excellent software manual makes all clear. With a pie-chart, it is possible to extract one piece of the pie or cake. This is a useful diagrammatic way of highlighting significant information. The menu prompt offers this option with the rather cryptic prompt: RELATIVE OFFSET DISTANCE FROM CENTRE (0 - 100%) which the manual explains means the distance you want the piece extracted. '100' positions the point of the triangular piece at the circumference of the pie circle, '0' doesn't extract it at all.

In addition to the main suite of prog-

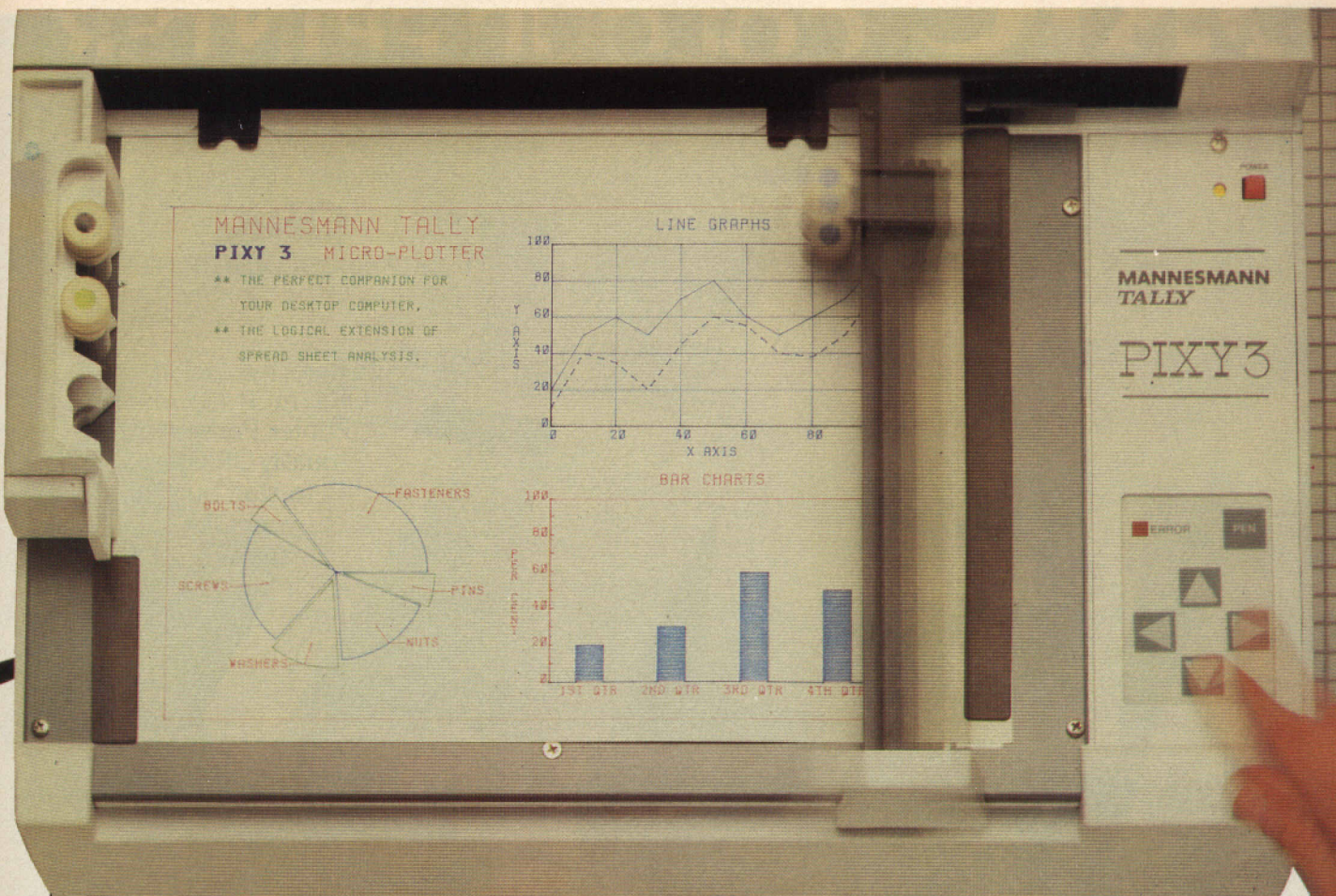
rams, the disk also contains a suite of sub-routines, starting at line 9000, so that any required commands can be added into your own programs. Documentation, together with lists of all variables used, instructions on how arrays must be dimensioned, plus specimen routines to call the relevant sub-routines, is provided but it might have been helpful if a hard-copy print-out of each sub-routine had also been supplied, perhaps in an appendix.

Sub-routines, and the main program, are both written in Basic. It is therefore possible for even tyro programmers to examine the listings to figure out how they work.

Data entry is really sophisticated. Not only does each set of data conclude with a chance to re-enter, but after a graph has been plotted, it's possible to call one, some or all of the data entries back for editing. With a bar-chart, for instance, it would be possible to enter '0' data for specific bars (resulting in a space between the bars). When calling these data indices back for editing, each number can be changed, and a different pen installed, to produce bars of alternate colours. One graph can also be superimposed on top of another, or grids can be saved on disk, so that different graphs can be plotted to the same parameters. The program can also process other kinds of data on disk, including DIF (Data Interchange Format) files generated by VisiCalc or one of the VisiClone spreadsheet programs now on the market. The program disk also includes three utilities, 'Read', 'Write', and 'Append', which can be used to examine, originate or concatenate data files.

In use

Remove the plotter from its box, where it is protected by the usual plates of expanded polystyrene, plug it in and connect it to the parallel port of the IBM, put the two disks supplied in the appropriate drives, turn everything on, and the system boots itself. After a brief copyright notice, you are asked to choose between Curve II program and Curve II Sub-Routines. The latter choice may cause some confusion, since though the sub-routines will LOAD, they cannot be RUN, and in fact execution of the program ceases at this point, so that users can write their own calling routines. Since the calling routine needs to define the variables used in the sub-routine, a DIVISION BY ZERO error will result from trying to RUN the sub-routines on their own. It would have been helpful if there had been some menu prompt to this



effect, since the explanation of what's going on is quite a way into the manual.

In general, however, the software works very well, and apart from occasional grammatical errors the software manual is well written and clearly printed.

Verdict

The hardware is really quite remarkable for its price, and when one considers that the software was originally written for the Watanabe plotter (UK price £1,129 — £3,074), the full value-for-money of the plotter-plus-software package at less than £800 can be appreciated.

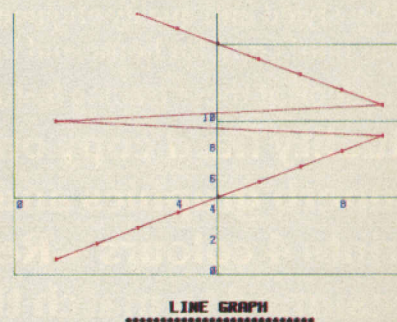
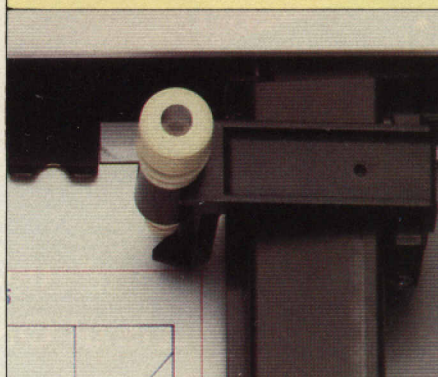
The hardware manual is well written and comprehensive, including full documentation of data transfer procedures, but this makes it rather technical and off-putting for the amateur or beginner, and the absence of programming examples means that the beginner would find it difficult to operate, if not impossible, without the Curve II software.

Initially it is available for connection to the IBM or (for £50 extra, plus VAT) to the Apple, but a wide range of other computer options are expected to be available soon including CBM, Tandy, NEC, North Star, and CP/M machines.

Item Pixy 3 plotter **Price** £688.85 inc vat (£746.35 serial interface version) **Interface** IBM Manufacturer Mannesman Tally **OS/Language** Controllable by software in IBM BasicA **Software** Program disk, data disk **Contact** (0734) 788711.

The Pixy Plotter reveals its small dimensions when scaled with its A4-size work area (top). The colour scheme matches nicely with the IBM PC, one of its work mates.

The pen arm is displayed (below left) when stationary. The system uses magnets. A magnet on the moving arm grips the pens securely for writing and a row of three magnets (below right) holds two of the three pens ready for action. When finished with a particular colour, the arm replaces the pen in its slot and picks up another. Examples of output from the Curve II software package show its flexibility.



POLAR EQUATION $R=f(\theta)$



Min/Max Polar Angle (°) 10/50

For those watching the pennies Ian Scales tests Brother's letter quality printer — the HR-15

Print with Brother

The HR-15 daisywheel printer is not so much a departure for its manufacturer, Brother, as a logical extension to the company's present range of typewriters and printers.

What makes the HR-15 different is its price. The printer is aimed at users who want letter quality output, aren't too worried about speed and have an upper price limit of about £500.

The HR-15 makes a nice finale to our letter-quality printers series because it comes from a company which is well-established in the office equipment market and has a well-deserved reputation for support. It also shows that manufacturers are taking notice of the new cost-conscious micro user who is often parting with his own, rather than his company's, money.

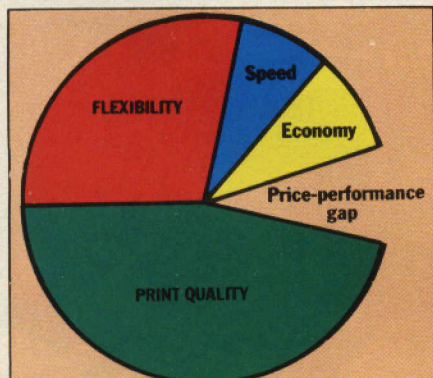
Setting up

The printer itself is what I suppose you could call aerodynamically styled. The moving bits and pieces are all tucked away under a bonnet which cuts the electrical circuit when it is lifted, so you don't get parts of your body caught in the machinery.

There was no difficulty experienced in inserting or removing either the ribbon cartridge or printwheels. They click in very easily. A full complement of touch-sensitive buttons enables you to self-test, form feed, select the pitch (how many characters you want per inch) and select the line spacings.

The important 'dip switches' are easily accessible at the rear, as are the built-in Centronics parallel or serial RS232 interfaces. The dip switches allow you to select your language group (probably standard English or ASCII in your case) and choose your page length. The switches also control the line feed and auto skip — where a feed is generated to avoid the perforations on continuous paper.

Daisywheel printers probably spend



A high printer capability in one direction will probably cause either a low capability in another or a higher price. Economy is a negative way of expressing price.

If a printer has lots of everything it will close the price/performance gap.



The HR-15 daisywheel printer is not so much a departure for
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most of their time using single sheet paper, although you can use continuous paper with this one if you wish. The HR-15 has a top of form facility to enable you to get the single sheet paper in without having to adjust the rollers — you simply seat the paper at the back of the platen and push a button. The printer takes over and feeds the paper in to the right spot to start printing. A paper support can be clipped into the top of the unit to help with the procedure.

Up and running

This is a slow printer, printing at about 11 cps. It is, however, capable of bi-directional printing which brings up the speed at which a page of text is printed. It is fairly quiet as the casing almost fully encloses the mechanisms. To compensate for the slow speed, the printer possesses a 3K buffer, expandable to 5K, which enables you to quickly download the contents of a single page to printer leaving your computer free for something else. As an added bonus Brother has included a 'copy function'. This enables you to leave

the printer to turn out multiple copies of a document without the intervention of the computer. The quality of the finished product is very high and there is a wide variety of typewheels available to vary it.

The documentation is adequate and reasonably understandable. The crucial dip switch settings are explained in table form and were lucid enough not to present any problems.

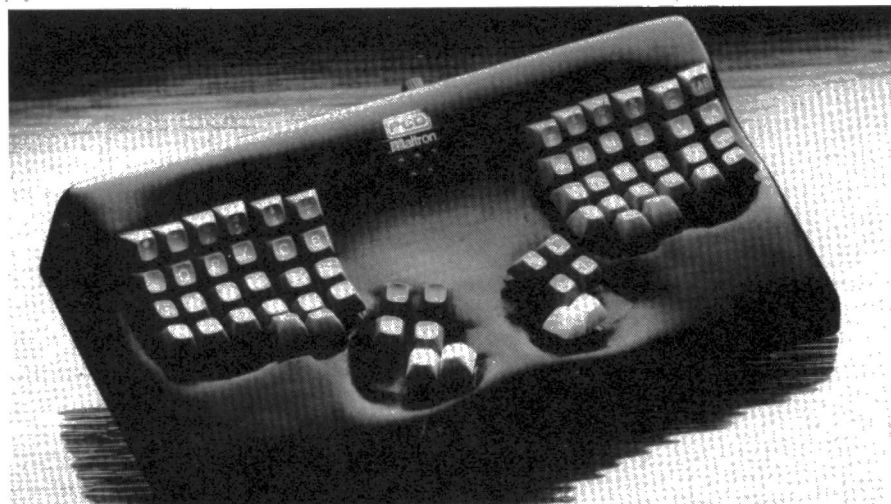
The all-important function or control codes are clearly explained. Using them it is possible to generate printing features like proportional spacing, auto-underline shadow print or red print.

This is an impressive product. Its pricing puts it within reach of many hobbyists or small businessmen and professionals who might previously have thought the cost of letter-quality printing too great to justify. It has a good quality feel about it and should prove a very competitive product.

Product Brother HR-15 Daisywheel printer
Price £540 plus VAT, Tractor feed £80 plus VAT, Sheet feeder £220 plus VAT **Interfaces** RS232 and Centronics parallel **Distributor** Thame Systems (084) 4215471

Is the qwerty keyboard out of touch? PCD Maltron thinks so and Ian Scales lays hands on its alternative.

Another type of keyboard



Not a case of keyboard meltdown... this is Maltron's alternative design.

When you think about keyboards, if you ever do, it might strike you as odd that we still use the old qwerty system — four rows of keys with 'qwerty' featured across the row, left to right.

Old habits die hard. Like many standards qwerty has become entrenched — after all it is much easier for manufacturers, employers and typing tutors to stick with a common system.

The keyboard Micropaedia (*PCN* issue 10) received such a response in the Random Access section of *PCN* we decided to take a closer look at one of the qwerty contenders — the Maltron keyboard.

As you may know, the qwerty keyboard was originally designed to slow typists down. The Victorian designer was faced with two problems. First and foremost he was designing the keyboard to directly drive a piece of machinery. If you've ever looked at the underside of a typewriter you can see that the idea of having four straight rows of keys was a good one, given the physical restrictions of the machinery. The qwerty system was designed, not for the operator, but as a mechanical system of levers and linkages capable of throwing the individual print arms at the ribbon and transferring the printed character to the paper.

Unfortunately, the early typewriters were prone to fall to pieces if pushed too fast, even when handicapped by the necessity for this rigid layout. So typewriter manufacturers were forced to take the inherently unfriendly design one step further by laying out the keys so they were actually difficult to get to when typing individual words. For instance, to type 'th',

probably the most commonly used combination of letters, requires a double index finger stretch. Perhaps the best place for these letters is straight under the index finger. If you touch type however, you find the relatively little used f and j in these two positions. So much for 19th century ergonomics.

The wonder of it all is that typists are still being taught to use a qwerty layout.

Cynics maintain that manufacturers still use the standard because the dealers can generate the word 'typewriter' on the top row of keys during demonstrations. But the truth is that the industry just hasn't got round to doing anything about it.

This is unfortunate when you think about the way computers interface with keyboards. It seems that now is the ideal time for some sort of change to be made. These days many newcomers are laying their hands on micros. As they've hardly touched a keyboard before, there is no reason why a qwerty layout should be propagated as the standard because 'people are used to it'.

A computer recognises an input character from the keyboard by constantly scanning a set of circuits. When a particular circuit is closed by the operator it recognises the character, sticks it in RAM and generates a character for the screen. There is no longer a design imperative for the keyboard to be laid out in any particular fashion; the keys simply need to be positioned above a set of printed circuits. They don't have to stand in straight rows, and they don't even have to face the same way. They can be designed around the needs of the human operating them instead of the needs of the machine.

The Maltron keyboard has been designed to do just this. The designer has taken the radical step of considering the way humans can best use their hands to do keystrokes. The end result was the keyboard shown on this page.

To cut a long and rather complicated process of scientific research short, the idea was to base the keys around the natural arc of the human hand. The next step was to work out the best way of positioning the individual letters and numerals on the keys to optimise their use in producing words. To do this the Maltron balances the load between the two hands. It reduces finger movement to a minimum by placing the most commonly used letters directly under the ten fingers (the home keys) and allows for the fastest finger movements to be used most frequently by carefully arranging the most common combinations of letters in the language.

Obviously the biggest benefits of such an approach are likely to accrue for professional typists where the accent is on producing more output in less time. But there is no reason why computer hobbyists shouldn't get in on the act too.

Easy to learn

As well as speed, the Maltron's other advantage is that it's very easy to learn to use. My own experience was that I could start remembering the letters far quicker than I seem to recall doing when learning how to touch-type on a qwerty.

For review purposes we had the keyboard hooked up to an old electric typewriter via an RS232 interface. I found I was able to punch the keys by memory within about 30 minutes. The best part of it is that there is very little desire to actually look at the keys.

For a programmer these advantages could pay dividends, especially in terms of avoiding errors. Unfortunately, it's early days for the Maltron. If you have several hundred pounds to spare the Maltron company will put together a custom version for you. At this stage of its life the concept has only found ready acceptance as an ergonomic system for the physically handicapped. It takes time and patience to make inroads against an almost universally accepted standard.

There is, however, a British micro system which uses the keyboard. An Oxford company, called Ergonics, manufactures a system called the Executive. It's an integrated Apple II system and as its name suggests it is aimed at the executive type who doesn't want to spend too much time at a keyboard learning how to use it.

In the meantime Maltron is providing a Switch Box and keyboard for the Apple at £342, and a configuration for the BBC micro is on the drawing board.

Item Maltron keyboard **Interface** Apple II (£342) or various on a one-off basis **Contact** PCD Maltron, Orchard Cottage, 45 Orchard Lane, East Molesley, Surrey KT8 0BN, 01-398 3265; Ergonics (manufacturer of the Maskot Apple), (0865) 50043.

Mick or Marilyn by Mupid? Ralph Bancroft finds new meaning in 'state of the art machine'.



Theo Bergstrom

Mupid masterpiece

A micro without a printer interface and with no software to drive the cassette interface may sound to you like a waste of time. But you would be wrong. The Mupid is no ordinary micro and a quick glance at the cover of this magazine and the illustrations in this article should demonstrate its capabilities.

The machine comes from Austria and has been designed as an intelligent viewdata terminal that can be expanded into a full microcomputer system.

The viewdata functions are entirely under software control and can handle both the UK Viewdata standards (as used by Prestel) and the Canadian standards (known as Telidon).

The distinction is important. Prestel graphics are alpha-mosaic. That is they are made up of chunky blocks of colour that make any life-like representations almost impossible. By comparison, Telidon is described as alpha-geometric. The screen resolution is much higher and the quality of the displays are, well, amazing.



Presentation

The various bits and pieces that you need to get Mupid up and running come in three anonymous cardboard boxes. Inside, the packaging is minimal. Just cardboard and a few flimsy blankets of foam. Any worries about the amount of protection afforded to the equipment were quickly dispelled. It was a demonstration model and had already been bundled in and out of cars many times before I threw it into a taxi to get it back to the office. It still worked first time.

Poulter Compuvision, which markets the machine, provides the all-important modem and the plugs and leads needed to get the system operational.

Documentation

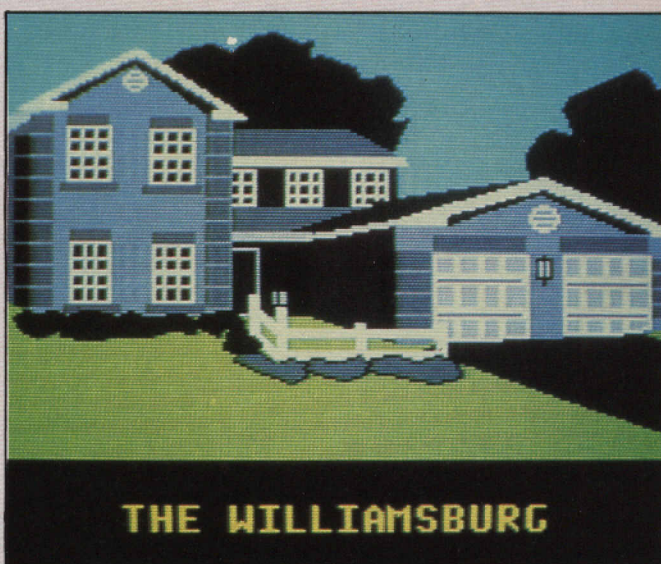
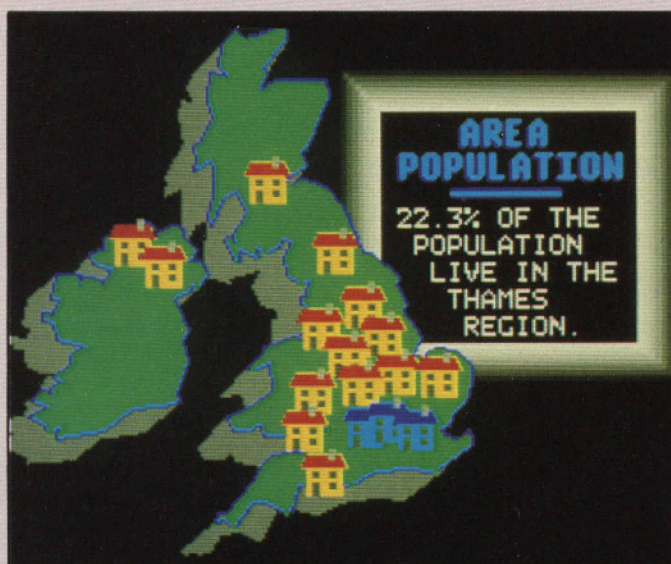
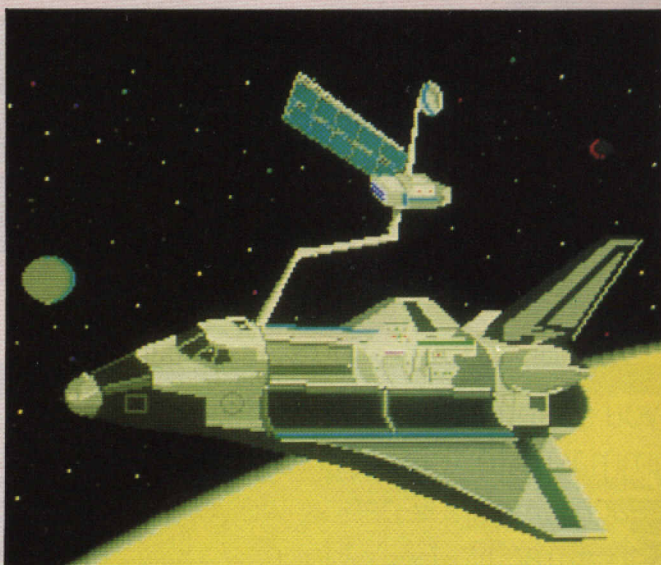
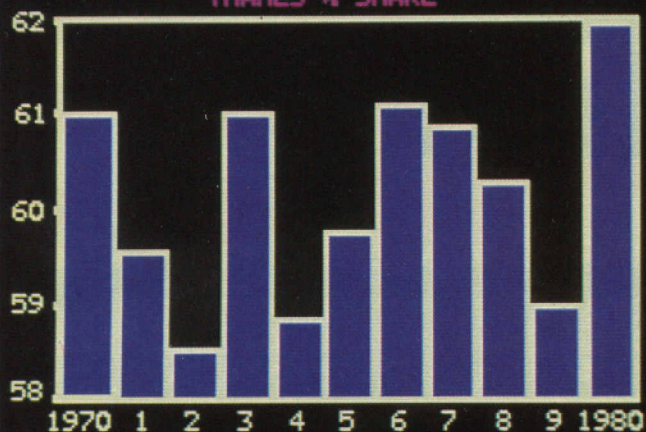
The documentation is almost non-existent. Poulter is still translating the Austrian manuals into legible English. In order to meet the demand for the Mupid it is supplying about 40 photocopied sheets of very basic information in a plastic binder with the machine. It has been written by someone who obviously knows what they are talking about but has little idea on how to present information to someone who doesn't.

The company says that because the Mupid is mainly being used by people needing nothing more than a viewdata terminal, the documentation provided should be adequate.

I for one doubt that. I claim some knowledge of computers and viewdata and yet found myself having to phone up to get

THAMES & LUT'S SHARE

THAMES % SHARE



further explanation on how to get the system to work.

Construction

Mupid comes as two separate, and somewhat ugly, units. The red wedge shaped unit houses the Z80 processor, 64K of RAM and 24K of PROM in a hard plastic shell. The grey keyboard unit is designed to overlap the processor unit. It also houses two sockets marked 'cassette' and 'printer'. Neither of these works yet because the software is not available.

The keyboard is laid out in the usual qwerty fashion together with a numeric keypad that doubles as a cursor control pad. The keys have a cheap feel with a lot of spring in them.

Idiosyncratic features of the keyboard are two special keys. One is blue and marked with a K (for Kommand!) the other is coloured red and marked with an R. When used with the 'ctrl' key it functions as a reset key. There is no 'esc' key. The code for this is generated by holding down 'ctrl' and pressing the '1' key.

Connection to the outside world is via three leads that run out of the back of the processor unit. One lead is for the mains. The power supply is housed inside the

processor unit with the result that the box gets very hot.

The second lead is the connection for the monitor. It terminates in a Cenelec plug which is very common on the continent but comparatively rare here. To get round the problem Poulter provided an adaptor box to give separate RGB and sync connections.

The third lead is an RS232C interface terminating in a D connector. This is used to connect the Mupid to an external modem. The literature suggests that there are two RS232C interfaces but I could not find the second.

Overall construction appears to be sound and capable of handling a lot of rough treatment. The equipment can be left on for extended periods of time and, apart from the tendency to get hot, does not suffer from any ill effects from long and continuous use.

Operation

When powered up, a circular Mupid logo appears on the screen. In the bottom right of the screen there are four coloured dots that indicate the current operational status. While under test I never saw these. This is probably due to the monitor we

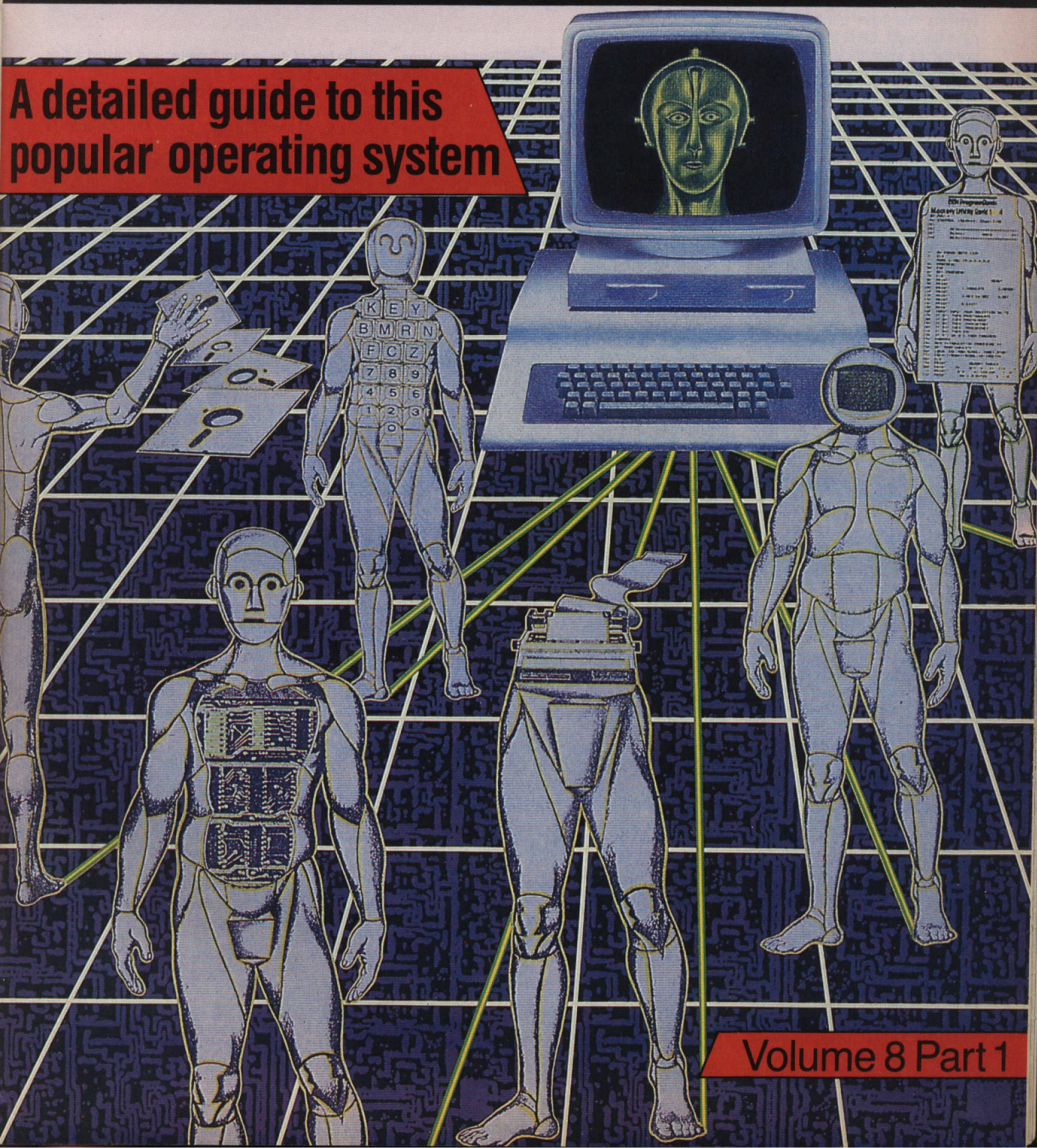
were using (a Normende TV/monitor) which may have responded to some internal tweaking to shift up the display. The screen had a distracting amount of wobble that could be quite a strain on the eyes with extended viewing. Again this could be due to the monitor rather than the Mupid but users would be well advised to try out several monitors.

The system software is easy to use once you have mastered the instructions. Keying K followed by C sets the machine to hook up to the telephone line. A dialling prompt appears on the screen and the keyboard starts to beep. You then dial up your viewdata service. When under test we used Prestel but it could just as well be a private viewdata service. When you hear the carrier tone from the computer at the other end you toggle the modem switch and replace the receiver. Mupid then takes over.

You have manually to key in your user ID code and password. After using an auto-dial modem with auto-logon software I found this process tedious. It is a shame that the very high quality of Mupid's viewdata software is not matched by the hardware. This sadly falls short of the technology that is now available.

CP/M

A detailed guide to this
popular operating system



Volume 8 Part 1

INSIGHT ON CP/M

The next two editions of Micropaedia will take an all-round look at the CP/M operating system.

This week we'll look at the history of the system, Gary Kildall — the man who developed it — and why it has become as popular as it is. Like most of the popular micro systems that have until recently ruled the roost, CP/M first became popular on eight-bit systems and has recently tried to make the great leap to 16-bit popularity.

We'll be looking at that leap and its success in the form of CP/M-86. And in doing so, we'll also look at some alternatives to CP/M — including Microsoft's MSDOS.

The great strength of CP/M has been its transferability among various micro systems — enabling you to run CP/M standard programs on a large variety of micros. CP/M has often been distributed in the form of disks, but it now comes built into many micros and can be invoked with a simple command.

Commands are the essence of CP/M and you'll get a good load full of them in the next sixteen pages — including lists of CP/M commands, their syntaxes, switches and options.

Although CP/M is usually associated with programs and software it is, in fact, largely in control of hardware. And as our cover shows, CP/M can control screens, printers, keyboards, memory allocation — and of course, disk drives.

To show you how the operating system accomplishes all these tasks, we'll take you inside CP/M and examine the Memory Map, how to call routines from within CP/M, the types of CP/M system calls and the best ways of accessing the console.

Once you've had a look round CP/M, you'll no doubt be even more curious to know how it does all its jobs. And we'll also tell you that, in a section that includes The Editor, the TYPE command, the file extensions and the SUBMIT transient program for batch processing.

And finally, we'll present you with a good idea of the equipment you'll need to run a CP/M system and what you can do with it when you get it.

WORKING THE SYSTEM

Back when computers were things that filled large rooms, and portability was a trait associated only with transistor radios, the chances of having a program designed for one system and yet able to run on another were slim.

Each mini (and micro) manufacturer seemed to have its own operating system for each machine. As far as micros were concerned, disk drives in those days (1973) were quite a luxury, and the operating systems (if you can call them that) were very complicated to use.

The Intel Corporation was quite young, and had a microprocessor division that was even younger. Intel at that time had upgraded the primitive 4004 microprocessor to the 8008 — an eight bit processor. But how to program the new microprocessor? The typical answer would have been 'in machine code', but it is tedious and boring. Being able to write programs in a high level language is much easier.

Intel had the idea to develop a high level language compiler for its mainframe, which would allow it to produce machine code programs that would run on the new microprocessor.

At the time, there was nobody in the corporation who was able to take on the mammoth task of writing a high level language compiler. After all, Intel was a hardware firm.

Which brings us to Gary Kildall. Kildall at the time was head of a very small software consultancy firm — Microcomputer Application Associates (MAA). MAA was approached by Intel and offered the job of writing the compiler. Taking up the offer Kildall produced a compiler for the new chip, PL/M which stands for Programming Language/Microcomputers.

If saying PL/M rings a bell with you, it is because it is still the standard development language for Intel microprocessors. Kildall adapted the ideas for PL/M from XPL — a compiler writing language.

Good use was made of the PL/M compiler. Intel produced the 8080 chip, and another young (at the time) company called Shugart Associates started to produce cheap floppy disk drives after IBM defined the 'standard' (See Disk Drives Micropaedia, PCN Issues 12 and 13).

Kildall was messing about with an experimental system at the time. He managed to get hold of a second hand Shugart drive. With this he fixed up a system including one drive, an 8080 processor board, teletype printer terminal and 16K memory. The operating system for it was written in PL/M, and was called control program/microcomputer — CP/M. The idea behind this was to allow the engineers at Intel to have their own micro development system, but Intel ironically turned it down.

It was quite different from the CP/M we all know today. For at the time, Kildall had problems in getting the system to communicate with itself. He got some help from one of his university professors who tacked

all the bits of the system together and created a disk controller board.

There are two important points which spring from this bit of CP/M history, one of which is still relevant today. CP/M has a command processor — in order to make it do something you enter a command. Kildall, who used to work for Digital Equipment Corporation (DEC) before MAA, was very much influenced by the operating systems that were used by the DEC-10 and PDP-11 machines. This often confuses people who use a DEC-10 and a CP/M based micro because of the slight differences in the command processor. It should be noted, however, that the internal workings of CP/M are radically different from DEC mainframe operating systems.

The second important thing to know about the early implementation of CP/M was its similarity to other operating systems insofar as it was system dependent.

There was no way to run CP/M on another system without some very major modifications to both the CP/M and the system.

The date now was 1975. Kildall was approached for some licensing agreements by Imsai. At this time he had the idea to take all the machine dependent bits of CP/M and place them in the BIOS section of CP/M. Here we have the beauty of CP/M. It would now be possible for the licensee to take CP/M and modify it slightly to run on any system. Micro manufacturers liked the idea of modifying an operating system. Manufacturers also liked the idea because their machines would be able (theoretically) to run any software written for CP/M. The software houses were laughing too, because if they could produce software to run on CP/M, and it would run on other machines instead of just one, they had a much bigger market.

A number of other events conspired to make CP/M even more popular. First, the computing press were taking note of this 'new' operating system, and one of the first articles on CP/M was published in 1975, titled 'CP/M an 8080 operating system'. Another boost in CP/M's popularity came from computer enthusiasts who took CP/M and developed programs to run on it — some of which are still used with CP/M. This group of enthusiasts formed what must be one of the oldest user groups — the CP/M user group. Meanwhile, the editor (ED), assembler (an 8080 version called ASM) and a dynamic debugging tool (DDT) were developed. Imsai was selling CP/M version 1.3 which evolved into what they called IMDOS. Imsai went bust shortly after.

There were problems with CP/M, however. It could only run on 8080 based systems and it was unfriendly to use. To be fair to Kildall, he developed CP/M to be used by electronic engineers and not the average operator. As far as the friendly error messages are concerned, some improvements have been made, but for Kildall back in 1975/6, another break was to happen.

Intel upgraded the 8080 to the 8085, but some of its engineers left the company to form what became Zilog Incorporated. Zilog produced the now famous Z80 microprocessor. The engineers of Zilog based the Z80 around the 8080, the same instruction set plus more made up the Z80. Any program written for the 8080 could be run on the Z80, and extra facilities could be added to its code, this making it upwardly compatible only. Although Intel tried to push the 8080 family of microprocessors, it was clear that the Z80 was the more popular, and more systems were sold with the Z80 chip than Intel's 8080.

By now, Kildall realised that he was becoming a megastar, and formed a new operation called

Intergalactic Digital Research, which soon dropped Intergalactic. Licences were sold and as the money came back to Digital Research the technology went forward. Besides the languages that were being run on CP/M machines, packages for accountancy and word-processing were being developed — Wordstar for example.

In 1979 CP/M was completely rewritten to recognise the increasing popularity of 5¼ inch drives and Winchester Hard Disks. At the time, CP/M was only configured to run with the IBM format eight inch drives. Now, with the modifications to CP/M, various drives could be used, and the operating system was that much more flexible.

SO WHAT IS CP/M?

CP/M is an operating system and a trademark of Digital Research. It is a general purpose operating system for the 8080 and Z80 microprocessors. It's also a disk and peripheral monitor which allows for the development and storage of application programs.

These programs would be executed by CP/M as well. CP/M can be, and is, used by operators, programmers and users. It benefits all parties concerned by providing two major facilities for a micro system:

- 1) the handling of all types of files on disk;
- 2) the handling of all I/O including the console.

CP/M does all the disk organisation, meaning that the user and programmer are freed of the troubles associated with allocating disk space to a particular file or files. Also, the VDU and other I/O tasks are handled by CP/M, so we can take for granted that CP/M will deal with all the tedious and difficult tasks, leaving the user to get on with the job at hand.

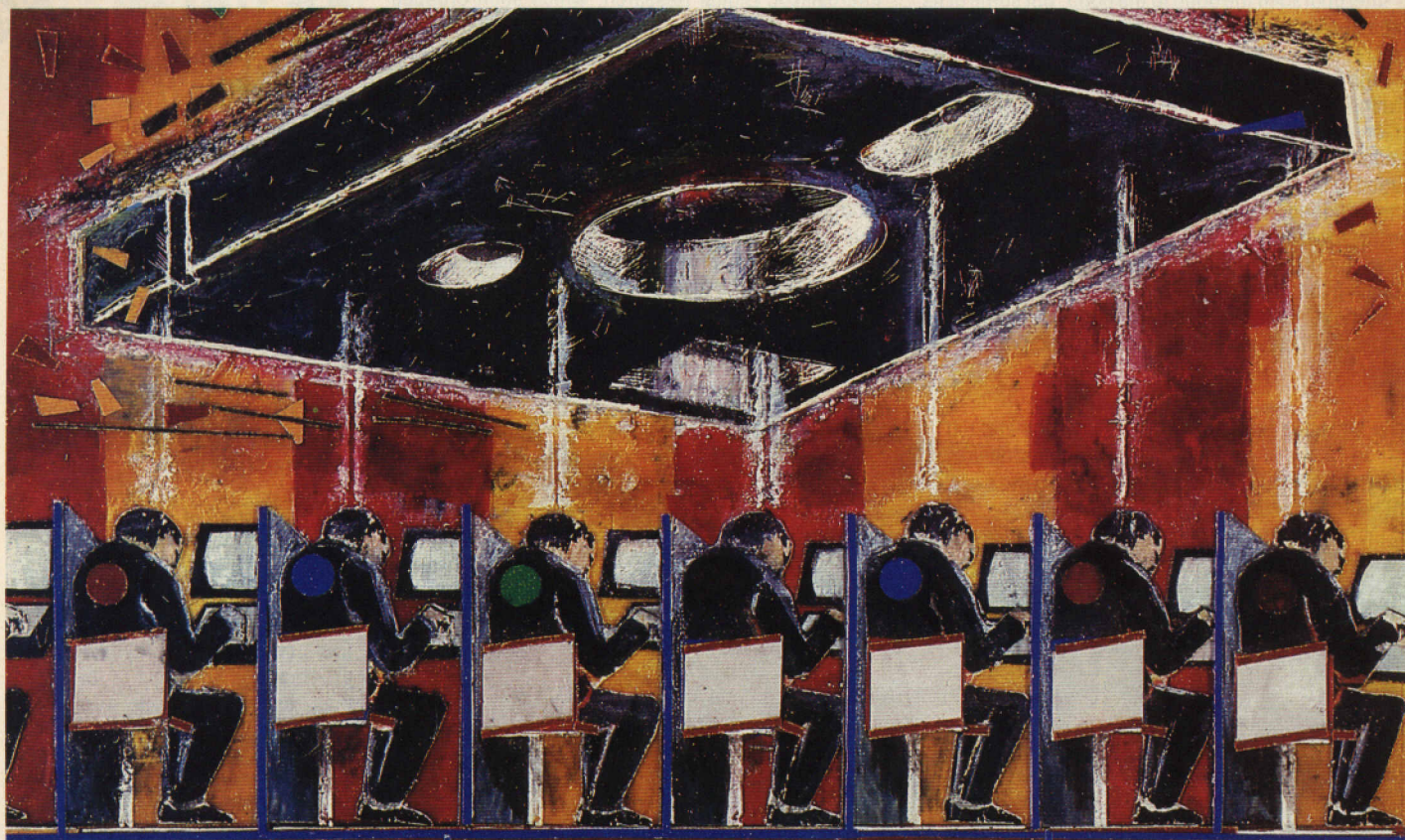
Another way to look at CP/M is as a housekeeper, you want to have the front room cleaned, you ask the housekeeper. CP/M is very much like the housekeeper, and you, the head of the house. If you want to delete a file called BLOGS, then you would enter a command to do so. CP/M would then do the necessary processing to make sure that BLOGS was deleted from the directory.

CP/M is held on the first track of the system disk it is supplied on, and the directory that it sets up is the centre track of the disk. Before using CP/M, it must first be loaded into RAM, and this is done by various methods depending on the system you are using. When in RAM, CP/M occupies two parts of memory. First, the lower end of memory is used by CP/M for the different function calls it uses. These are explained elsewhere in Micropaedia.

The top or high end of memory is used by CP/M to hold the command processor, basic input output system (BIOS), and the basic disk operating system (BDOS). The programs that are run on the system occupy the 'middle' area of memory which is referred to as the TPA, or Transient Program Area. One interesting point to note is that the boundaries of CP/M can be quite easily amended, thus allowing for extra memory to be installed.



Gary Kildall, the man who started it all by developing PL/M, and later, the early version of CP/M. The DEC-10 (top) was one of the first machines to run CP/M.



SMART OPERATOR

CP/M is sufficiently general to support a wide variety of applications, across a wide variety of hardware. It is reasonably safe to say that any program ever written for an 8-bit micro could have been written under CP/M. In fact, given the huge choice of programming languages, editors and debuggers, CP/M is a superb environment for program development and a well-written CP/M program is only limited by the micro-power and capacity of the machine.

A particularly strong point in favour of CP/M is that it frees the programmer from concern about most of the nit-picking details of the peripherals to a particular piece of hardware, leaving him to concentrate on the design and implementation of the software. Thus he need never be concerned with, say, the baud rate and interfacing details of the VDU, or density and file structure of disk drives, etc. All these problems are taken care of by the CP/M BIOS (Basic Input/Output System) and BDOS (Basic Disk Operating System). But of course there are limits to the generality, and anyone attempting to write a maximally portable program should be aware of them.

SPOT THE DIFFERENCE

CP/M will run on computers with either the Zilog Z80 or Intel 8080 processor. However, whereas the Z80 can execute any code written for the 8080, the converse is not true. So, to achieve maximum CP/M portability, code should be 8080 and not Z80 based. By the way, this information is pertinent to high-level language programmers just as much as assembler programmers. It is important to check whether the high level language can run on one or both processors, or if it is a compiler, whether the generated object code is for Z80 or 8080 processors.

Certain Z80 instructions, such as "block move", are so powerful that it is a pity to avoid using them if the Z80 is available. It is possible for an assembler program to detect which processor is in use, using the block move instruction if possible, and an 8080 subroutine if not. The trick is to use a carefully coded jump instruction. For example a relative jump, that will be ignored by an 8080 processor (which does not recognise relative jumps) and taken by a Z80 processor.

Different versions of both the Z80 and 8080 processors run at different speeds. Processor speed is quoted in MegaHertz (millions of cycles

per second), and frequently quoted speeds are 2 and 4 MHz. Simplistically, we can expect a 4 MHz processor to execute programs twice as quickly as one at 2MHz. This fact should be taken into account when programming delay loops, or any feature of the system which needs to keep track of time. For example a typing tutor may need to record the user's speed in words per minute, or a game may become unreasonably fast if it happens to be running on an ultra-fast processor.

RAM differences

Most 8-bit micros nowadays come with 64K of RAM as standard, however CP/M can run on systems with a little as 20K of RAM. Obviously it is important to establish how much RAM the software needs. It is easy for a program to discover the amount of space available to it and fail if there is not enough. In Basic:

```
PEEK(6) + PEEK(7) * 256
```

```
or in 8080 assembler:
```

```
LHLD 0006
```

can be used to find the address of the first location in RAM not available to the program. This is the start of the BDOS and BIOS code. Clearly this code cannot be overwritten by the

program, unless the program is not going to do any disk or other I/O. Note that there is no particular problem about overwriting the CCP (Console Command Processor) as this part of CP/M, used to interpret directly keyed commands (like "DIR" and "ERA", etc) is not needed when a program is actually running. If the CCP is overwritten then the program should terminate by rebooting CP/M so that the CCP is read back into memory.

Some Z80 and 8080 machines can support more than 64K of RAM, but the processors, with just 16 address lines, can only generate 2^{16} (=64K) different permutations of addresses. The extra RAM can only be accessed by "bank selection". This involves using some special sequence of instructions to switch out one memory board (or part of it) and switch in some other board in its place. Of course, the contents of each board are unaffected by these operations, so when a board gets switched in again all its contents are preserved. Unfortunately, there is no particular standardization for handling bank selection so programs relying on this lose a good deal of portability.

Disk differences

CP/M systems run on machines with 80K disk drives and machines with 8000K disk drives. As with RAM it is important to establish how much disk space the software needs. Unfortunately CP/M provides no ready means for determining the amount of space on a given disk. A crude method would be to write a measured amount of data to a file until a disk-full condition is encountered, then delete the file. The measured amount of data is the available space.

More realistically, it is preferable to set limits on any aspect of the system which depends on disk capacity (eg maximum number of transaction records in an accounting system). These basic figures can be set up and tested during installation of the software (using a specially written installation program).

A further point: not all CP/M systems have just two disk drives denoted A and B. Users with hard-disks or silicon disks, which might be denoted by any letter up to P, may especially want to use software on some other drive, and it should be possible to do so.

VDU differences

Many CP/M systems do not have a physically distinct VDU. Both screen and keyboard are integrally housed with disk drives and circuit boards, etc. Other CP/M systems have a more traditional look about them, with a lead to an external VDU.

In fact, although physically very dissimilar, the difference poses no particular problem for the software. Integral screens have memory-mapped displays — the display is modified instantaneously by changing a value in some reserved part of RAM. Each machine has its own convention in this respect, so software that works this way will not be portable, but ... CP/M to the rescue! When CP/M is running on these machines, programs can write characters to the screen in the same way as they would with any other CP/M system. The CP/M BIOS sorts out all the memory-mapping. As far as the software is concerned the character might as

well have gone to some remote VDU.

VDUs do however present one major barrier to software portability. Most high-quality micro-software needs to use cursor addressing and possibly different display modes. Unfortunately the different VDUs have no standardization for this, and there is not even any real agreement on screen size although 80 by 24 is very common. Also many VDUs have special function keys and arrow keys, etc, but there is no standardization on the codes they generate.

To overcome these problems it is not usually necessary to code up different versions of the program for different VDUs since, fortunately, most VDUs do use the same kind of system, and it is usually possible to limit the special character sequences, and let the user set up his particular information when the system is first installed.

Finally an ever-increasing number of VDUs have differing high resolution graphics facilities. It is almost impossible to allow for this, so anything using graphics is almost guaranteed to be non portable.

Printer differences

Much of the foregoing on VDUs also applies to printers, particularly if they are used to plot graphics.

But most printers have a 'lowest common denominator', differing only with respect to paper dimensions and selection of say, two different print densities.

Each machine has its own unique version of CP/M, but the differences between these versions are supposed to be invisible to the software running on it. All these differences lie in the coding for the BIOS which is not directly accessible, and in fact not generally documented either.

The really different versions of CP/M are versions 1.4, 2.2 and also its multi-user incarnation MP/M. CP/M 1.4 was superseded so long ago that it is probably not worth taking into account. From 8080 assembler, a rogue 1.4 version or MP/M version can be detected by:

MVI C,12	;Select function 12
CALL 5	;for BIOS call
MOV A,H	;HL now set with version
ANA A	
JNZ MPMVSN	;Taken if MP/M
MOV A,L	
ANA A	
JNZ CPMVS2	;Taken if CP/M 2.0 or later
JZ OLDCPM	;Taken if CP/M 1.4 etc

The principal features of version 1.4 and MP/M, where they differ from version 2.2 are:

Version 1.4. Random access filing is not available. Some of the CP/M transient commands, like STAT and PIP are weaker than in version 2.2.

MP/M. Although this is a completely different operating system, albeit a multi-user version of CP/M, a great deal of code written for CP/M will run under MP/M. In fact there are other CP/M compatible operating systems, such as Cromemco's CDOS and CPN. There are all sorts of environmental problems with MP/M which has enhanced facilities for controlling the multi-user environment.

CONTROL COMMANDS

CP/M has a number of commands — they are of two types: transient and external. And they enable you to write, edit, compile, or run a program as well as keeping track of your disks and memory.

With every version of CP/M, you should receive a copy of a text editor called ED. This is a simple yet effective text editor, which can be used for many applications from entering machine code to writing source code. Here is a list of the commands available in ED:

nA Append n lines or line. ±B Move the character pointer to the beginning (+) or end (−) of the edit buffer. B#T. Move the character pointer to the start of the edit buffer and display the entire buffer. ±nC. Move the character pointer forward or backward n characters. ±nD Delete one or more characters (denoted by n) in front of or behind the character pointer. E End the edit session. A file with the extension filename .BAK is made which contains the unedited version of the file as well as an edited version. nFstr ↑ Z. Find the string (str) once or n times, end command with control-Z (↑Z). H Perform an E command and then re-run ED.COM to edit the file you have just edited. Istr Insert string and move the character pointer to the end of the inserted characters. istr For version 2.2, this inserts upper and lower case and works the same as I. ±nK Delete following (+) or previous lines (−) ±nL Move the character pointer up or down n lines, if n=0 then move to beginning or end of current line. nMstr ↑ Z Repeat execution of the string (str) commands n times. nNstr ↑ Z Search for the nth occurrence of string (str) within the text file. O Omit the edit session and leave the file as it was. ±nP Display n pages of the buffer previous to (−) or following (+) the character buffer. Q As O but a previous filename .BAK file will be deleted. Rfile Read from filename and insert text into buffer. nSold ↑ new ↑ Z Find oldstring in buffer and substitute for newstring, repeat n times if n is specified. ±nT Display the following (+) or previous (−) lines. ±U Translate all characters typed in upper case or turn off translation (−). ±V Turn on (+) or off (−) line number display. Note the line numbers are not actually included in the file.

CP/M and all that

CP/M is a special "control program" which can be used on most (8-bit) microcomputers with disk drives. It can only handle one keyboard and screen. Thus it is a "single-user" system, not "multi-user" (where a single computer may have several VDUs in use simultaneously).

The name CP/M is an acronym for "Control Program/Monitor", not, as is often reported: ".../Microcomputer" — more meaningful, but historically incorrect. There are several other such microcomputer control programs, or "operating systems" as they are generally called: MS-DOS, CP-M86, (CP/M's 16-bit big brother), UNIX, DOS 3.3, etc. All of them have their various merits and demerits, but CP/M deserves special attention because it has been long-established and is so widely available.

From the viewpoint of someone simply wanting to run an application such as word-processing or accounting, CP/M has one major feature to offer: choice! You can safely ignore many of the internal facilities and workings and bask in front of the huge catalogues of competitively-priced software available for CP/M.

However, very few CP/M packages are complete 'turnkey' systems, and activities, typically formatting newly purchased disks, or transferring data from one disk to another, must be performed using CP/M commands. So application users need some basic familiarity with the simpler aspects of CP/M and of course application writers (ie programmers) need even more.

The basics

The important point to grasp about CP/M is that if it is the operating system on your computer, then you can forget who manufactured your machine. It will behave in a virtually identical fashion to any other machine with CP/M. Of course different micros have different disk and internal memory capacities, performance, looks and reliability, etc. CP/M does not iron out these differences, but you will find that once you have learned CP/M on one machine, then you can readily use any other as well. One word of warning: although you may be able to readily switch between different CP/M machines, the same may not be true of your programs and data. As a rule of thumb don't expect any disk usable on one make of computer to be easily readable by another.

Many purchasers of CP/M actually buy it at the same time as they buy the computer. Often CP/M is included in the overall price. Don't try and negotiate a discount for not taking CP/M, unless you are sure there is an alternative operating system.

In spite of their special status in the software world, operating systems are simply ... software. Thus CP/M comes supplied in the same way as any other software, on a floppy disk with accompanying documentation. This documentation is either the Digital Research original material (eight slim manuals) or some reworking of this, courtesy of the computer manufacturer.

To get started simply insert the disk, and switch-on or "boot" the computer. The disk should whirr for a second or two and then the VDU will display some copyright message and CP/M version number. Version 2.2 has been available for many years, although owners of stone-age micros may still have the older 1.4 version.

Perhaps you are wondering why you cannot just switch-on the computer and use it without a disk at all? Well on most disk-based computers it happens to be the case that at the moment the power hits their circuits, all internal memory is filled with random data, and they are incapable of even the most elementary activity. They are completely insensitive to the keyboard, unable to send information to the VDU, etc. They actually need programs to do all this, and these

programs are stored on the CP/M disk. At the moment of switch-on, just one fixed area of memory is not filled with random data, having a permanently burned-in ('bootstrap') program which can get the disk moving and read a specially selected area ('system tracks') of it into internal memory. If the disk happened to contain the CP/M operating system in that area, then that is what the computer gets started with. The process is called 'bootstrapping' or 'booting' for short, because getting the computer going is the software equivalent of lifting yourself by pulling your own bootstraps.

If you are an applications-user then you will only need to learn about a very small part of CP/M. CP/M has a wide range of facilities, including assembler and debugging programs, etc, and you certainly will not need to learn anything about them. Don't be put off by all their documentation.

Hard-core CP/M

Once CP/M is operational, it indicates that it is ready for you to type something, by displaying a prompt "A>". Anything you type will be echoed after the ">", and the significance of the "A", is that the disk drive "A" is the current drive. If no drive is specified in a command then A will be assumed by default. This default can be changed by typing "B:" or "C:" etc, whereupon the input prompt will change to "B>", etc.

★ **Directory.** It is obviously very useful to discover what information is stored on any given disk and CP/M has a facility called DIR (short for "directory") to do this. Simply type in "DIR" at the keyboard and the disk will start whirring and the VDU will display a list of files on that particular disk. It is possible to use DIR with an accompanying ambiguous file name, to list only the files that match the name, or for files on various disk drives, etc.

★ **Erase.** Another basic facility is the ability to erase a file using the ERA command. This command is used in the same way as the DIR command, except that it will not work under certain circumstances. For any command that writes or erases information, the disk affected must first be 'logged in'. This is done by pressing the 'Control' and "C" keys simultaneously. This need only be done once, when a disk is first inserted, but it is quite easy to forget, and then an ERA command will fail with CP/M's infamous 'BDOS error' message. No harm done — the command should simply be retyped.

★ **Type.** Obviously the ability to examine the contents of files is essential and the TYPE facility can be used for this. It is not possible to use it with ambiguous file references, so only one file can be typed at a time. Any file can be typed, but many files are in some internal 'binary' format, and appear as complete gibberish on the screen. Consult the accompanying table of file extensions for some guidance as to which files are likely to contain human-readable text. The TYPE facility can also direct output to the printer — simply press control-P before doing the TYPE command. In fact this directs all subsequent interaction to printer and screen together, so DIRectories can be printed as well. The facility can be switched off by a control-C or a further control-P.

★ **Rename.** It is occasionally necessary to rename a file. For example when restoring a backup file to normal status. The REN command achieves this.

Ambiguous file references

Many CP/M commands must be accompanied by a file reference to operate on. This can sometimes be deliberately ambiguous, in order to operate on several files simultaneously. Ambiguous file references use:

*	to match a sequence of characters in a filename
?	to match a single character
For example:	
AB?D.*	ambiguously matches with "ABCD.TXT", "ABXD.COM", but not "ABCCD.TXT"
.	matches with everything
*.TXT	matches with all "TXT" files
????	matches all files with a primary name of 4 characters
AB*.*	matches all files starting "AB"

File names

Many CP/M commands must be accompanied by a file name on which to operate. File names are split in two parts separated by a full stop, but many commands permit the disk drive to be specified as well. Thus a file reference can have three parts:

Drive-name	A single letter: A, B, . . . P identifies the drive on which the file is located.
Primary-name	Up to eight characters. Preferably some mnemonic or abbreviation indicating what the file is or does.
Secondary-name (Extension)	Up to three letters. Usually some abbreviation indicating the type of file, eg text, program, data, etc. The following conventions are used:
ASM	Program written in assembler
BAK	Backup (ie out of date version)
BAS	Program written in Basic
COB	Program written in Cobol
COM	Executable code (transient command)
DAT	Data
DOC	Text (program documentation)
FOR	Program written in Fortran
HEX	Hexadecimal dump (text)
OVR	Program overlay
PAS	Program written in Pascal
PRN	Annotated program printout
REL	Relocatable code
SUB	Text for use with SUBMIT command
TMF	Temporary file
TXT	Text
\$\$\$	Incomplete or unreliable file

All three parts of a file reference are keyed-in on just one line, but separated from one another by a colon and full stop. Thus "B:FRED.TXT" identifies the file whose primary name is "FRED", secondary name is "TXT" and is currently located on the disk in drive B.

If the disk drive identifier is omitted, most commands assume a default of "current" disk drive.

Basic Transient Programs

The facilities so far covered are built-in — they do not depend on the presence of special files in the disk drives before they can work. Thus they are always available, right from the moment CP/M has been booted. Referring to the memory map, the code for the built-in facilities lies in CCP area (and also uses code above it).

There are several other essential facilities, not "built-in", which do things like disk formatting and file-copying, etc. These facilities, called 'transient', appear as files on the supplied CP/M disk, all with the extension ".COM". To use one of them simply type the name, omitting the ".COM" part. If the file is on a disk not in the current drive you will need to prefix it with the drive identifier. Once again, referring to the memory map, ".COM" files are transferred to the TPA when their name is typed. They are 'transient' because they get overwritten as soon as another program is used.

■ **Formatting.** Unfortunately this is not a standard CP/M facility, although all CP/M systems must have a format-command. It is usually called "FORMAT" or "INIT", etc, and a typical syntax would be "FORMAT B:" to format the disk in drive B.

■ **File transfer.** Once a disk has been formatted, files can be transferred to it using the PIP command. Simply type "PIP B:=A:.*" to transfer all files from disk A to disk B. This may take some time if there are lots of files to be transferred.

■ **CP/M transfer.** None of the facilities mentioned so far actually access the system tracks on the disk, the area used when the computer is booted. All CP/M systems have a facility for copying these tracks from the initial supplied CP/M disk to newly formatted disks, sometimes modifying the information along the way. Once this has been done, the computer can be booted with the new disk.

■ **Status information.** The transient program STAT.COM can be used in various ways. At its simplest, it works rather like the directory command, but gives more comprehensive details than "DIR", including

file sizes, and space left on the disk, etc.

■ **Submit.** It sometimes gets tedious, repeatedly typing the same sequence of commands — for example using PIP to backup a sequence of files. Using the SUBMIT facility the typing need only be done once. First a text file needs to be created with an exact copy of the text that you would normally be typing at the keyboard. The text file must have the extension ".SUB". Once this file has been created, any time you need that sequence of commands, simply type "SUBMIT FRED" (if the text file is called "FRED.SUB") and CP/M will use the text in the file, just as if it had come direct from the keyboard.

Most high-level languages completely shield the programmer from the peculiarities of the operating system — so, a Fortran program for a CP/M system need not look very different from one for some other operating system (except for constraints on program size, etc).

CP/M provides a comprehensive range of facilities for controlling all the peripherals, including disk drives, under program control.

The first 51 location in the BIOS contain a jump table, providing the full range of basic input and output functions used by CP/M (hexadecimal addresses for a 64K system).

Type of I/O

	FFFF	Rest of BIOS
Disk	FA30	JMP SECTAN sector translation
Printer	FA2D	JMP LISTST return printer status
Disk	FA2A	JMP WRITE write selected sector
Disk	FA27	JMP READ read selected sector
Disk	FA24	JMP SETDMA set DMA address
Disk	FA21	JMP SETSEC set sector number
Disk	FA1E	JMP SETTRK set track number
Disk	FA1B	JMP SELDSK select disk drive
Disk	FA18	JMP HOME track 0 of selected disk
Reader	FA15	JMP READER read character (reader)
Punch	FA12	JMP PUNCH write character (punch)
Printer	FA0F	JMP LIST print character (printer)
VDU	FA0C	JMP CONOUT write character (VDU)
VDU	FA09	JMP CONIN read character (VDU)
VDU	FA06	JMP CONST return VDU status
System	FA03	JMP WBOOT — CP/M warm start
System	FA00	JMP BOOT — CP/M cold start

Built-in commands

DIR	Directory. Displays directory of files that match the (un)ambiguous accompanying file reference. For example: DIR displays all files on current drive DIR B: displays all files on drive B DIR A:*.TXT displays all "TXT" files on drive A DIR FRED.TXT displays "FRED.TXT" if it is there.
ERA	Erase. Erases unrecoverably all files that match the (un)ambiguous accompanying file reference, for example: ERA *.* erases everything on current disk ERA B:*.BAK erases all BAKup files on drive B
REN	Rename. Renames a file. Cannot use ambiguous references and cannot specify two different drives, or rename to an existing name. REN A.BAS=A.BAK renames "A.BAK" to "A.BAS" REN B:XYZ=B:PQR renames PQR to XYZ (on drive B).
TYPE	Type. Types a file on VDU screen, cannot use ambiguous references. TYPE FRED.TXT types out the file FRED.TXT TYPE PIP.COM types out PIP.COM, unrecognisable to the human eye
SAVE	Save. Saves an image of memory onto the disk. Irrelevant to applications users
USER	User. Rarely used — more pertinent to MP/M

CP/M PART 1

However it is essential to use assembler code to use these.

There are 37 different CP/M functions available to the assembler programmer, numbered 0 to 36 (see side panel). The relevant CP/M function is selected by setting register C to a number in the range 0 to 36, followed by a "CALL 005". Usually other registers need to be set as well, or examined after the call. A typical calling sequence (to print "*" on the printer) would be:

```
MVI C,5    ;Select list output function
MVI E,"*"  ;We want to output "*"
CALL 0005  ;Now do it
```

CP/M comes complete with a range of transient programs to aid software development in 8080 assembler: ED — a text editor (widely regarded as useless), ASM — an 8080 assembler and DDT — a debugger. There are also LOAD and DUMP programs for converting binary files into hexadecimal formats.

Memory Map

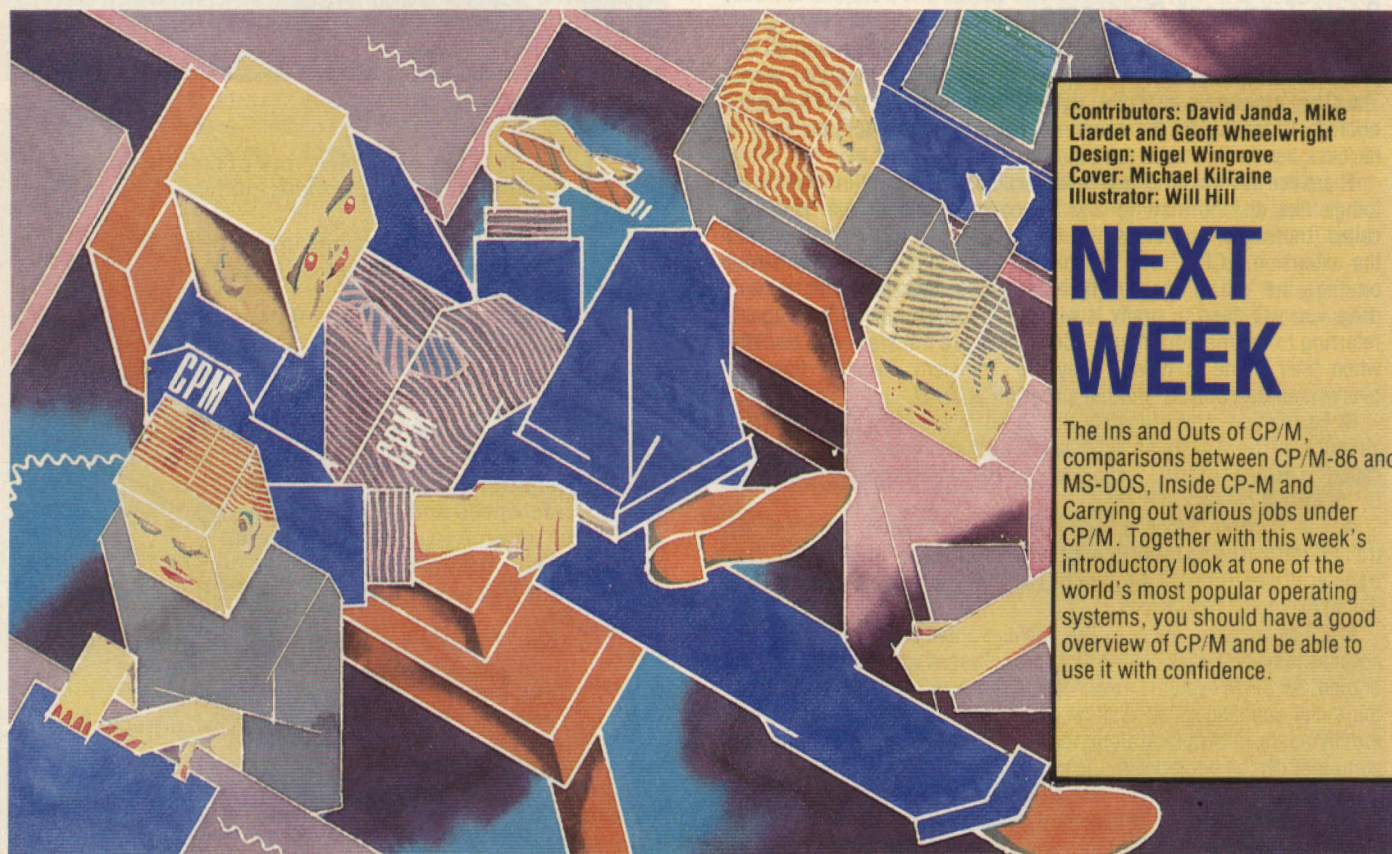
For 64K system (addresses given in hexadecimal — all addresses greater than 0100 should be reduced accordingly for smaller systems).

Top of memory

	FFFF	BIOS
	FA00	(Basic Input/Output System)
		BDOS
FBASE	EC00	(Basic Disk Operating System)
		COP
CBASE	E400	(Command Control Processor)
		TPA
TBASE	0100	(Transient Program Area)
		DMA
	0080	(Direct Memory Access-disk buffer)
		FOB
	0050	(File Control Block)
	003B	Reserved scratch area for BIOS
	0008	Z-80 and 8080 restart vectors
BDOS	0005	JMP FBASE instruction
	0004	Current DRIVE number
	0003	IOBYTE
BOOT	0000	JMP REBOOT instruction

List of CP/M System functions

Function No	Function
0	System reset
1	Console input
2	Console output
3	Reader input
4	Punch output
5	List output
6	Direct console I/O
7	Get I/O byte
8	Set I/O byte
9	Print string
10	Read console buffer
11	Get console status
12	Return version number
13	Reset disk system
14	Select disk
15	Open file
16	Close file
17	Search for first item matching filename
18	Search for next item matching filename
19	Delete file
20	Read sequential from file
21	Write sequential to file
22	Create file
23	Rename file
24	Return currently available disk drives
25	Return current default disk drive
26	Set DMA address for disk I/O
27	Get address of "allocation vectors"
28	Write protect disk
29	Get read-only vector
30	Set file attributes
31	Get address of disk parameter
32	Get or set user code
33	Random access file read
34	Random access file write
35	Compute file size
36	Set random record



Contributors: David Janda, Mike Liardet and Geoff Wheelwright
Design: Nigel Wingrove
Cover: Michael Kilrairie
Illustrator: Will Hill

NEXT WEEK

The Ins and Outs of CP/M, comparisons between CP/M-86 and MS-DOS, Inside CP-M and Carrying out various jobs under CP/M. Together with this week's introductory look at one of the world's most popular operating systems, you should have a good overview of CP/M and be able to use it with confidence.

Once in to Prestel, Mupid operates like any viewdata terminal. Until, that is, you loop into some rather special pages put up by Poulter to demonstrate the advantages of Telidon graphics.

Switching between Prestel and Telidon graphics is entirely transparent to the user. All that is seen is a page display featuring alpha-mosaic and alpha-geometric graphics. Using a normal Prestel adaptor you would see a page partly filled with chunky Prestel graphics with the remainder of the screen taken up by a stream of seemingly incomprehensible characters. (Readers with a Prestel terminal or adaptor should go to page *70954# and look at Mupid's demonstration pages).

These characters are the heart of the Telidon system. Viewdata pages are built up using a sequence of Easy Readable Codes (ERCs). What you see on Prestel is an optimised version of those codes.

A Mupid user can create his own pages, or amend an existing one, using the graphics editor. This is downloaded from

Prestel as a telesoftware program. The telesoftware downloader forms part of the Mupid operating system and again its use requires no operator intervention. Looping into a selected telesoftware page, the Mupid automatically detects it and downloads the program.

With better documentation the graphics editor should be fairly straightforward to use. In the alpha-mosaic mode a few simple ERCs can create the desired effect. For example, to create a band across the page with the words 'Personal Computer News' written in cyan-coloured double height characters on a blue background the user would enter the following codes:

dh cb bn cc 'Personal Computer News'. Here, dh specifies dual height, cb and bn the blue background and cc the cyan colour for the text that follows.

Seven colours can be specified in this mode and can be made to flash at two different speeds. Mosaic elements can also be specified along with their colours, set at one of two levels of intensity.

To generate the impressive Telidon graphics you have to switch into the alpha-geometric mode using a '%\$' instruction. You then have a series of codes available which include the drawing of DOTs, LINEs, ARCs, CIRCles, RECTangles and POLYgons. Entering one of these codes followed by a 'ctrl c' takes you to a graphics screen with an on-screen cursor. Moving this around the screen you can specify both the size and the position of the desired shape.

You can specify whether the shape should be open or filled. Filled shapes may be solid or textured.

Pressing the 's' key stores the coordinates of the points that delineate the shapes. Returning to the screen listing the codes, you will find that all the data has been automatically coded.

Having created or edited a page what do you do? There is, at the moment, no cassette or disk system to store it. It is possible, however, to put it back down the telephone line and store it on the viewdata



A graphic of a PDP 11/03 image creation terminal created by itself.

The 'K' is for Kommand.

computer. All you need is the required passwords.

Basic

The Mupid can also be used as a personal computer. On Prestel there are a few programs that you can download and run including a German vocabulary course and a couple of games — Mastermind and Brick out.

In addition you can download what is described as a 'Basic Compiler'. Next to no instructions came with the documentation on how to use it, although this will be rectified when the printed manuals become available. However, trying out the so-called compiler quickly proved that it is not a compiler but a Basic interpreter. Pending the arrival of the disk and cassette systems it is difficult to see much use being made of it.

Expansion

Poulter is the first to admit that the Mupid is still at an early stage of development. In the pipeline are enhancements to the graphics editor and the Basic compiler.

More importantly, a 1Mb dual disk system running under CP/M should be available from the end of August together with a serial printer interface. By the end of the year there will be memory expansion modules (up to 128K), PROM pack expansion modules, graphics tablet, a facsimile module (for digitising images using a TV camera), a mouse, games paddles and a cassette system.

Support

Poulter Compuvision is a relatively new name in the computer field. The parent company is an advertising agency which took an interest in Telidon as an advertising medium. As with any new computer company the level of support the user can expect is as yet to be demonstrated. I found their London office more than helpful.

Verdict

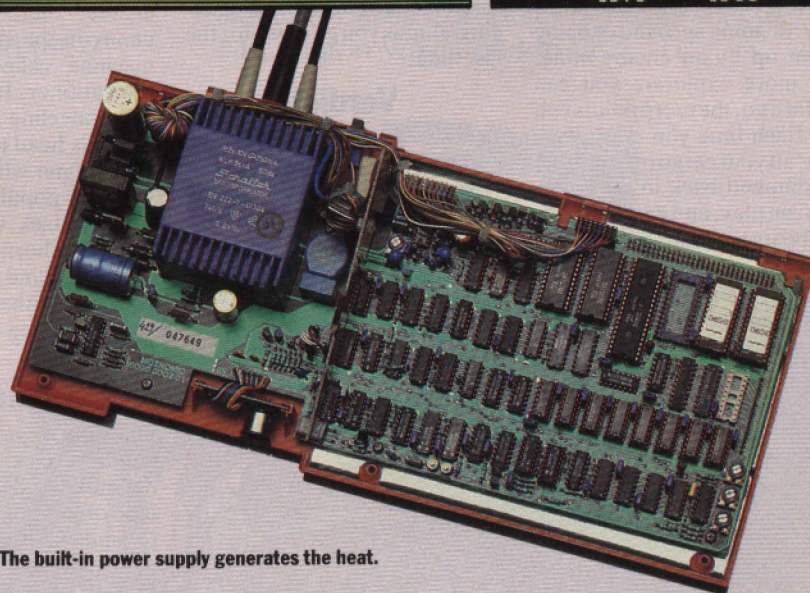
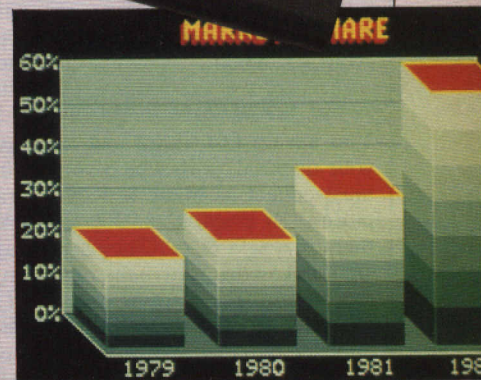
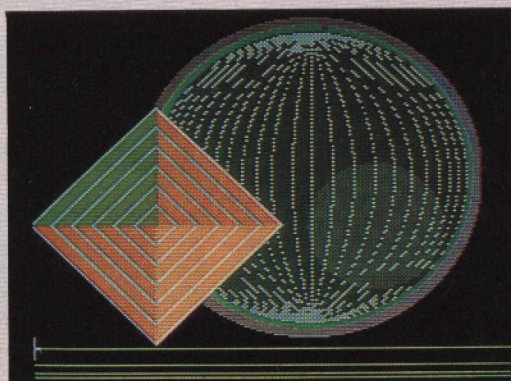
As an intelligent viewdata terminal the Mupid can generate very impressive graphics. So much so I have had great difficulty in keeping PCN's art department away from it. I share their enthusiasm. High quality graphic presentation is undoubtedly important in conveying information and the Mupid does this to great effect — at a price.

Understandably, the machine is mainly finding a market among companies requiring a private viewdata service that is a cut above what Prestel or Prestel-like systems can provide.

With the arrival of cassette and disk systems and printer interface later this year its potential as a personal computer system can be fully explored.

The level of support from the distributor has yet to be proved and so far the amount of software to run on it is minimal.

And who needs a cassette or disk to run the software? Just phone up Prestel, download the program of your choice and away you go.



The built-in power supply generates the heat.

SPECIFICATIONS

Price	£978 inc VAT
Processor	Z80A
RAM memory	64K
PROM memory	24K
Text screen	Teletext format
Graphics screen	320 x 240
Colours	Seven at two levels of intensity with two flashing frequencies
Keyboard	62 keys, detached including numeric keypad cum cursor control
Storage	Twin disks and cassette systems due end of August
Operating systems	Dual standard viewdata. CP/M disk due end of August
Distributor	Poulter Compuvision Systems, 2 Bureley Road, Leeds. 0532 469611
Software	Viewdata system in PROM, free graphics editor, Basic and games packages downloadable from Prestel.

ATARI ACTION

ATARI 400/800 A sinking feeling

Name River rescue **System** Atari 400/800, joystick **Price** £25 approx
Publisher Thorn EMI Video (01) 836 2444 **Format** Cartridge **Outlets** Laskys, Atari dealers

Forget those hackneyed racing-driver games, jettison those old-hat flight simulators. Now you can get your kicks by piloting a much older form of transport in the privacy of your Atari... a boat.

Objectives

You have a fast motorboat at your disposal, with which you must collect as many lost explorers as possible and land them in a safe place. They are stranded on the north bank of a crocodile-infested river, and you have to land them on the opposite bank without running into a crocodile, or ramming a jetty, or going aground or being blown up by an enemy mine. The more explorers you can land at a go, the more points you get. Each time you crash your boat, all your cargo of explorers are dumped back in the river. Two can play, and each one gets five boats to crash.

In play

This game moves fast, and you have no control whatsoever over the speed. As soon as you hit the start button, your powerboat is off and running.

The main obstacles are is-

lands, and moving things which I assume must be crocodiles, or Loch Ness monsters. It's very easy to run into the riverbank as you're swerving to avoid a crocodile tail. Every so often, a pair of jetties come into view, and you can screech to a halt by either the one on the north side of the river, to rescue somebody, or the southern one, to let them get off before they die of seasickness.

If you can manage to collect a boat-full of explorers you score a bonus for delivering them to basecamp. I was still dumping no more than five, and that was with my fourth or fifth boat. I found that the early stretches of the river were harder than some bits later on.

The graphics are hard to fault, and the sound effects are quite satisfying. Each time you crash a boat, you get a pleasing crunch and a shower of sparks as it sinks. Each time you rescue an explorer, there's the sound of running feet as he or she gets on board. And when you finally sink your last boat, there's a tolerable attempt at a glug-glug-glug as you go down for the last time.

Verdict

This is a game to get the adrenalin gurgling and the eyes crossed and the fists clenched hard enough to dig holes in your palms with your nails.

Shirley Fawcett

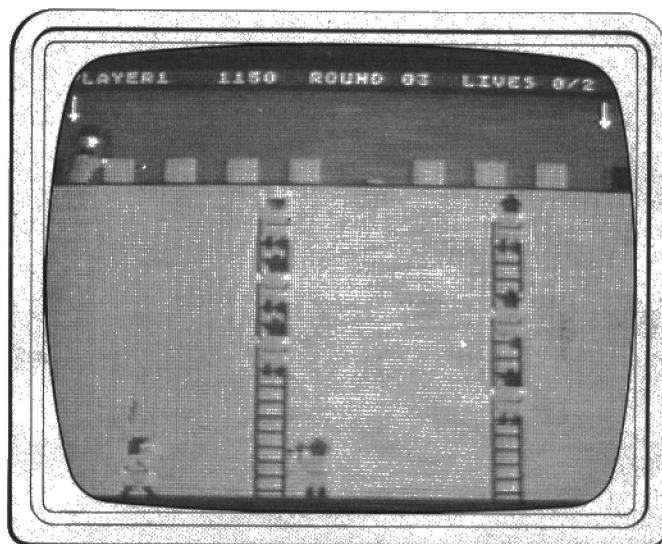
RATING

Lasting appeal 🐼🐼🐼🐼🐼

Playability 🐼🐼🐼🐼🐼

Use of machine 🐼🐼🐼🐼🐼

Value for money 🐼🐼🐼🐼🐼



ATARI 400/800 Don't lose your head

Name Orc Attack **System** Atari 400/800, joystick **Price** £30 approx
Publisher Thorn EMI Video 01-836 2444 **Format** Cartridge **Outlets** Laskys, various Atari dealers

In Littlehampton's amusement arcade, there used to be a penny-in-the-slot puppet machine called the Chinese Executioner. It showed a prisoner kneeling at the block to have his head lopped off by an executioner with a large axe. It was very popular.

Orc Attack, the newest game from the Thorn EMI stable, has the same kind of bloodthirsty fascination that used to have them queuing for the Executioner.

Objectives

One or two can play. The castle is under attack. You are the sole defender, and all you can do to fend off hordes of Orcs is to run to and fro along the battlements, picking up and throwing rocks, boiling oil, and fencing with whichever Orcs have managed to climb their ladders.

In play

The graphics are only too good in this game, presumably to let you extract the last drop of delight out of the bloody bits. You control a person in a rust-coloured frock or tunic, and using the joystick, you make this hero run left or right along the battlements.

The Orcs come tripping onto the scene in neat formation, ladders over shoulders. Their

bowmen immediately start letting off bolts in your direction, but they're so randomly scattered that you'll have to try really hard to get hit by one.

You, meanwhile, can pick up rocks from either end of the battlements, then steer yourself into position to drop them on the two or three pile-ups of Orcs trying to climb up the battlements. Steering is none too easy, but can slow your progress by keeping a finger on the fire button.

Once an Orc has got to the top, you engage him in combat with a sword till you knock him off his ladder, or he knocks your block off. From time to time, the swords are replaced by boiling oil, so if you can get to the end of the battlements in time, you can pick up a potful and pour it onto the Orcs below. The ground at the bottom of the screen catches fire, and any Orcs still down there disappear into the holocaust.

If you fail to defeat the Orcs, the scene is equally gruesome. Your head is hewn from your shoulders, and falls to the bottom of the screen in glorious Technicolor. This will certainly happen to you sooner or later in this game — when you get as far as tackling the sorcerer, say, or the Stone Warts.

Verdict

This game is slow and not all that easy to play, but it's one of those games that will succeed on the strength of its graphics alone. Personally, I was horrified by it, but I found myself still playing it two hours later.

Shirley Fawcett

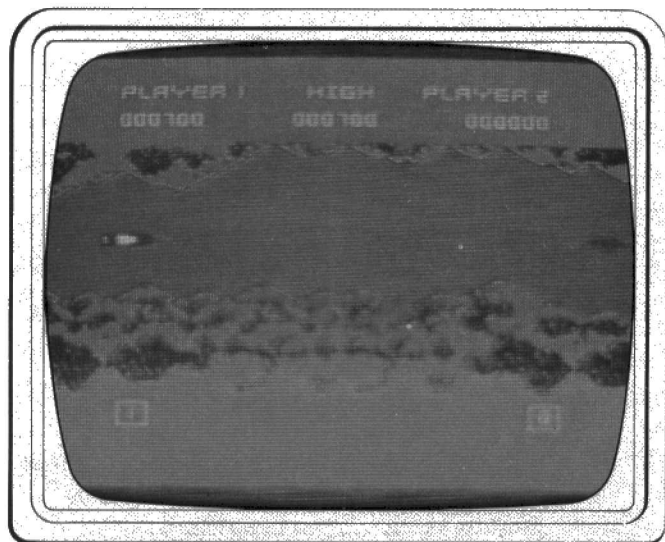
RATING

Lasting appeal 🐼🐼🐼🐼🐼

Playability 🐼🐼🐼

Use of machine 🐼🐼🐼🐼🐼

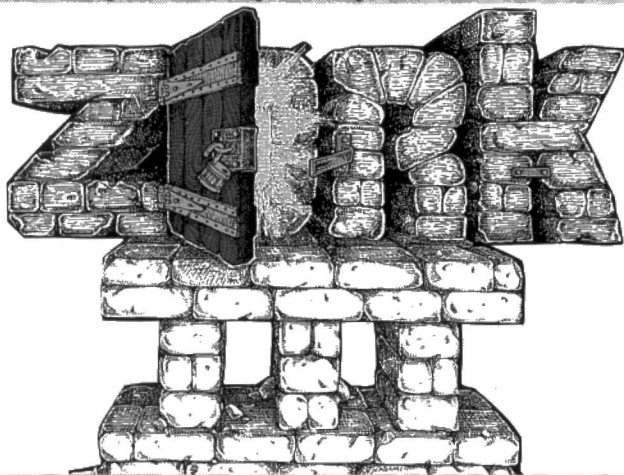
Value for money 🐼🐼🐼





ADVENTURE

ATARI, APPLE, IBM, TRS80



Name Zork I, II, III **System** Commodore 64 **Price** £29.95 each (£74.95 for trilogy) **Publisher** Infocom Inc., 55 Wheeler St., MA 0128, USA **Format** Disk **Language** Machine code **Other versions** Atari 400/800, Apple II, IBM PC, Texas Professional, TRS 80 **Outlets** Carousel Software, 36 Harlow Park Crescent, Harrogate, Yorks HG2 0AW

Zork in triplicate

Have you ever heard of the Great Underground Empire? Do you know what a grue is? Can you name a microcomputer game that has its very own user group? Do you know what program a 1983 American readership poll showed to be the all-time most popular adventure? If you answered 'yes' to all four questions, then you'll know I'm referring to Zork. If not, twenty minutes of play with one of the adventures in the Zork trilogy will burn the name forever in your memory.

Although Zork I: The Great Underground Empire has been around for a while, only now has it become available for a wide range of micros, including the Commodore 64 and Atari. There are also two other programs in the series, Zork II: The Wizard of Frobozz and, very recently, Zork III: The Dungeon Master.

Objectives

The trilogy is linked but any of the adventures can be played in isolation. The Great Underground Empire has you searching for treasure in a large labyrinth beneath the earth. Here you will be confronted with perils and situations from the mystical to the macabre.

The Wizard of Frobozz sets

you in a long-hidden region of the Empire. Here the wizard rules with his magical powers which occasionally come unstuck. Some lovely touches of humour in this one, though danger still abounds.

The Dungeon Master is your ultimate test of wisdom and courage — discover the secret purpose of the Dungeon Master, your destiny hangs in the balance.

First impressions

Each of the Zork programs comes attractively presented in a bubble pack, containing the disk, a handsomely printed booklet giving the background to the adventure and how to get started, together with a reference card for use with your particular machine and a brochure on the Zork User Group. The group is an independent body, licensed by Infocom. They offer such goodies as books of clues, illustrated guide maps, a full colour poster, and badges.

In play

Zork has a set of puzzles that will require more than a fair bit of common sense to solve. It is unlikely you'll successfully complete any of the Zork adventures in days.

Zork uses a far more realistic command structure than most other adventures. You can talk to it using sentences and multiple commands. For example, you could say 'Take all but the

knife and the lamp' or perhaps 'Take the book then north. Drop book and candle'. Questions can be asked using 'What' and 'Where'. For example 'Where is the gold?' or 'What is a grue?' You can even talk to characters in the Adventure, eg 'Tell the wizard "READ THE SIGN".'

There are many possible routes to the successful completion of a Zork adventure. Problems may have more than one solution. They might not need to be solved at all, though its fun trying!

The program has two useful options. You can have a printed copy of every input and response by using the command SCRIPT to give you both screen and printer output. It can be turned off by the command UNSCRIPT. You can also choose how the location descriptions will be displayed. In normal mode, you will get a full description of each location the first time you enter it. Thereafter only the room name and any objects there will be displayed. Typing L or LOOK any time will produce a full description of the current location. Using the command VERBOSE gives full descriptions whether or not you have been in the room before. SUPERBRIEF gives the room name only. BRIEF will return the descriptions to normal mode.

Time passes only in response to your input so that if you want to spend a few minutes (or hours) pondering your best course of action, you may do so without penalty. Points are accumulated by gaining entrance to certain locations and for obtaining treasure. If you get killed, you can be brought back to life — you will lose points, though.

Like most good adventures, there are options which allow you to SAVE a game at a particular position and RESTORE it later, playing on from the point where you originally saved it.

If, when faced with a rather unpleasant looking tunnel, you prefer not to boldly go where no sensible man has gone before, then you will want to save the position before venturing further. You can always pretend you didn't really get killed by using the RESTORE command after the unhappy event. If you happen to get killed, there is always the possibility that Zork will bring you back to full health. However, it is unlikely to be in the same place and will cost you points.

Zork allows you to have up to eight differently named game positions at any one time. The program gives simple directions for you to follow when saving or restoring a game. The only drawback is that because of the way the program uses the disk, a directory listing will not show you what games you have saved. Each Zork adventure comes on a single disk which cannot be backed up. A pity but only to be expected. Infocom offers a 90-day warranty on the disk — if the disk becomes defective after the warranty expires, it will replace it for \$15 provided the disk is returned.

Verdict

The programs are not cheap but they are worth every penny.

Bob Chappell

RATING

Lasting appeal	★★★★★★
Playability	★★★★★★
Use of machine	★★★★★★
Overall value	★★★★★★

>NORTH

Dragon Room

The room is a large cavern full of broken stone. The walls are scorched and there are deep scratches on the floor. A sooty dry smell is very strong here. A Paved Path winds from a large Passage to the west, through the room, and across a cyclopean stone bridge to the south. To the east a small crack is visible. A dark and smokey tunnel leads north.

A huge red dragon is lying here, blocking the entrance to a tunnel leading north. Smoke curls from his nostrils and out between his teeth.



GAMES IN 3D

SPECTRUM

The rites of string

Name Knot in 3D **System** 48K
Spectrum Price £5.95 **Publisher**
New Generation Software,
Freeport, Bath BA2 4TD **Format**
Cassette **Language** Machine code
Outlets Boots, Mail order

Even 3D maze games can get repetitive. But Knot in 3D contrives to be an interesting and innovative game by standing the 3D maze concept on its head.

Objectives

Imagine a three-dimensional space. Next, think of yourself as being in control of a ball of string unravelling in this space. You must unwind this ball through as much space as you can without ever getting back to a point which your 'string' has already covered.

If you then think of a number of other balls of string moving through the same area, and whose trails you must avoid, you should get a fair idea of the game's object. You thread your way through a maze you've built yourself, with the aid of rival tracers, gaining points for the amount of ground you cover, and losing points for the number of times you bump into a trail.

In play

The hardest part about Knot in 3D is understanding the basic concept. You are a little cross in the middle of the screen —

whereas some adventure games make you very cross all over the screen — and the various trails rush up to meet you in large 3D blocks. Your task is to get round/past/over/under them.

Initially I found it difficult to remember that it was actually the stationary cross that was doing the moving, but once you've got your brain in step with the way the program's going it's relatively plain sailing.

Once you've got this far you can start motoring. Your role is to change the direction of movement rather than decide whether or not to move, and as the knot gets thicker you have to go through all sorts of permutations to survive.

Although you can get a respectable score by just waltzing through your void until things get tight, you've actually got to plan to get up there with the big boys. Planning isn't my strong suit, so I had to make do with mediocre scores and regular 'you have been knotted' messages.

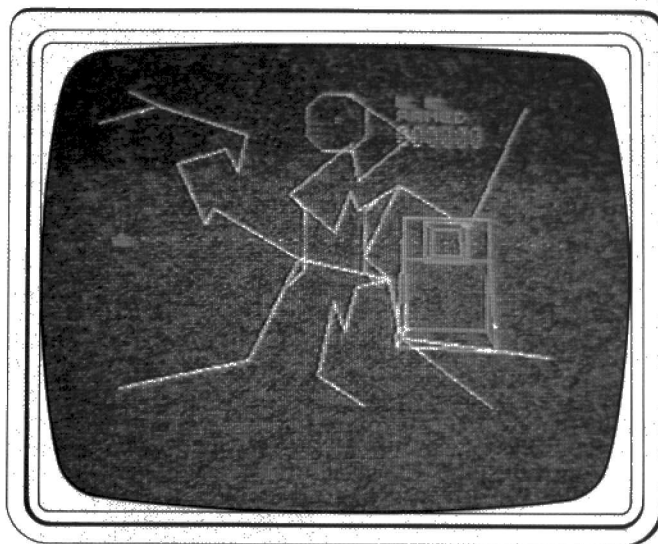
Verdict

I don't think Knot in 3D will teach you much about strategy, although if you're a maths genius it might; however, it certainly does sharpen up your reactions. Just a few months' basic training on this one, and when the next generation of 3D air combat games comes on the market...

John Lettice

RATING

Lasting appeal	★★★★
Playability	★★★★
Use of machine	★★★★
Overall value	★★★★



SPECTRUM

Shells a-poppin

Name 3D Combat Zone **System**
48K **Spectrum Price** £5.95
Publisher Artic Computing, (0401)
43553 **Format** Cassette **Outlets** Mail
order and dealers

Stand by for yet another impossible arcade game running on a 48K Spectrum. Aim... Fire! Artic's Combat Zone is a blow-for-blow reproduction of the arcade original.

Objectives

You command a tank on an eerie plain inhabited by wire-frame landscapes. Every now and again a shadow dashes from cover to cover. Enemy tanks lurk behind every obstacle. And it's kill or be killed.

Once you get good at it, the enemy gets a little tougher with Flying saucers and Supertanks arriving to back up the initial wave of deformed looking gunships.

In play

Combat Zone is neatly presented, and LOADED first time. It runs with a reasonable set of five keys or Kempston joysticks. Don't worry if you haven't got sticks — the keyboard arrangement is very like the levers used in the genuine old original. The only gas about the presentation came in the LOADING instructions. 'Assemble the cassette tape at the silent part before the program'. PCN's cassette, at least, arrived in one piece.

The radioactive wasteland is a little unnerving. Although

you've got an inexhaustible heap of ammo, it takes a while to reload between shots. If you're taking enemy tanks, you either get them in two shots or start running for one of your three lives. They dodge your fire with incredible precision... and then they turn on you. They never miss.

Your vision's a bit limited too. Apart from the temptation to do a quick Blue Danube just to watch the superb graphics, your outlook is frighteningly narrow. Fortunately, you've got a radar screen which neatly locates and positions the bad-dies. At least you get a vague warning that they are coming up behind you. Just before you (and your windshield) crumble into oblivion.

Combat Zone is a remarkable piece of programming. I didn't think anything I could see on the Spectrum could surprise me any more. But the graphics are great... despite colour limitations. Only the Spectrum's feeble sound spoils it.

The game itself will hook those who enjoyed the original. It takes a while to bag your first villain, but becomes progressively easier afterwards. Apart from slinking round looking for flying saucers, the magic fades.

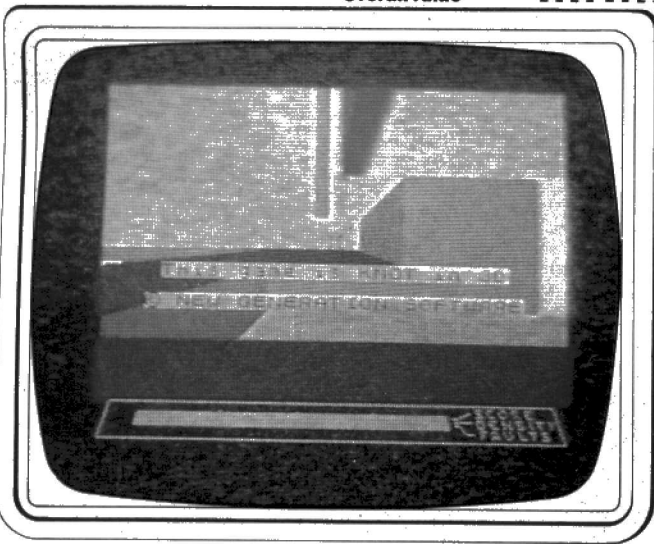
Verdict

I hate to say it, but this has to be a must for anyone with a serious Spectrum collection. And of course, if you played the original, this will provide a good fix in your own home. Can't be good for the nerves though.

Max Phillips

RATING

Lasting appeal	★★★★
Playability	★★★★
Use of machine	★★★★
Value for money	★★★★



ADVENTURE

ORIC Out with a ring

Name Moria **System** 48K Oric **Price** £6.95 **Publisher** Severn Software, 5 School Crescent, Lydney, Glos **Format** Cassette **Language** Basic **Other versions** Spectrum **Outlets** Mail order, Laskys, various Oric dealers.

Riddle — what sort of a game is set in a many-levelled underground realm, with treasures to be collected and a mysterious ring to be found, and orcs and balrogs to be battled with, and wizards and traders to be bargained with?

An adventure game this isn't, even though it has all the trappings of any classic adventure you care to name. Exactly what it is... well, judge for yourself.

Objectives

You have been dumped in the Mines of Moria, and you have to find a way out. That in itself may not seem like such a bad thing, since the mines are the former hangout of Durin and the Dwarves of Lord of the Rings and are riddled with gold and jewels.

But there's always a catch — you can't get out of the mines without finding Durin's Ring, and to find it you have to explore dozens and dozens of rooms which may or may not contain monsters. You can either fight or run away, but either way you're going to run out of strength sooner or later.

And when you do, or you are too badly wounded by taking on an orc or troll, then it's curtains.

In play

The graphics and sounds are nothing special. You start out in one of the game's umpteen levels. You can move north, south and so on, or up and down if you stumble on a staircase.

Each room is a plain blue square until you enter it. Then it either turns white, to show that there is nothing inside, or it clears to reveal... gold, or a pearl, or an emerald, or a ruby, or a wizard, or a trader, or...

You may find you have stumbled on the Warp, which whisks you to a random room.

There are also doors from time to time, which you have to open by using up some of your strength, or your money, or a spell, which you buy from a wizard.

Once you have miscalculated, running low on strength or high on wounds from battles, your best bet is to find some treasure and take it to a trader, who will sell you extra strength.

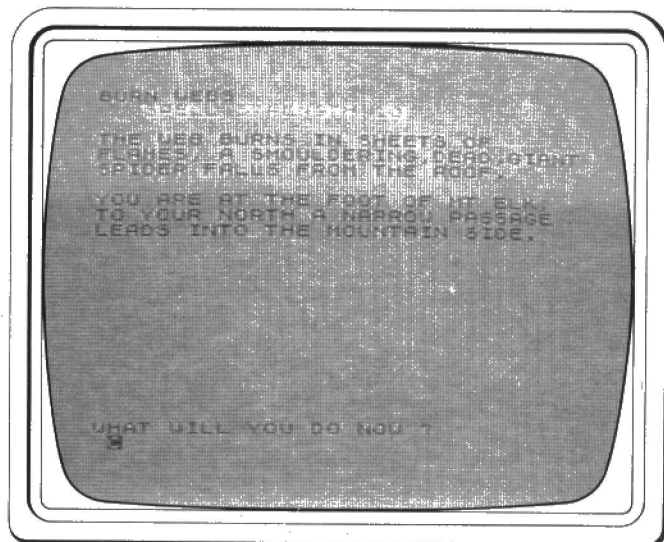
Verdict

I never found the ring, and that was after exploring most of the 36 rooms on each of seven levels. Played cautiously, this game could keep you going for hours. And it makes a change from the usual style of adventure.

Shirley Fawcett

RATING

Lasting appeal	★★★★
Playability	★★★★
Use of machine	★★★★
Value for money	★★★★



SPECTRUM Conquer the demon

Name Velnor's Lair **System** ZX Spectrum 48K **Price** £6.50 **Publisher** Neptune Computing, 98 Howe Street, Gateshead, Tyne & Wear NE8 3PP **Format** Cassette **Other Versions** BBC model B **Outlets** Mail order

Playing an adventure game is the nearest you can get to a Sinbad type of voyage. But once you've played a few, the same elements keep cropping up — a rescue or search of some sort, with a touch of danger thrown in along the way.

Velnor's Lair is no exception and gives its dose of the usual formula.

Objectives

The Black Wizard Velnor is about to realise his ghastly ambition to become a true demon on earth. There is only one hope for mankind, that one brave adventurer can penetrate Velnor's defences and surprise him before metamorphosis is complete.

To take on Velnor you can be a priest, warrior or wizard. Each character has different strengths and weaknesses.

Before you start you'd better draw a map or you'll probably get lost. And beware: Velnor is a master of illusions.

In play

Dressed as a warrior, I arrived at the foot of Mt Elk carrying a torch, club and tinderbox. With my torch lit I moved towards a narrow passage to the north. On arrival I was told the

passage was blocked with thick yellow webs — and asked 'what will you do?'

Well, I burnt the webs and down dropped a giant dead spider from the roof — phew! I hate spiders.

After going in and out of several passages I ended up in a dusty cavern, slashed through with crevasses which were spanned by a small bridge. Being careful I entered the command 'examine bridge'. And guess what, it was an illusion, another close shave and with the command 'E' I went East.

The next thing I knew I was fighting my way through fungus growths, the air filled with fungi spores and I was choking to death. Desperate, I tried to go north, south, east, west — anywhere! But my luck had run out and in one swoop I was choked to death to the sweet sound of music.

Verdict

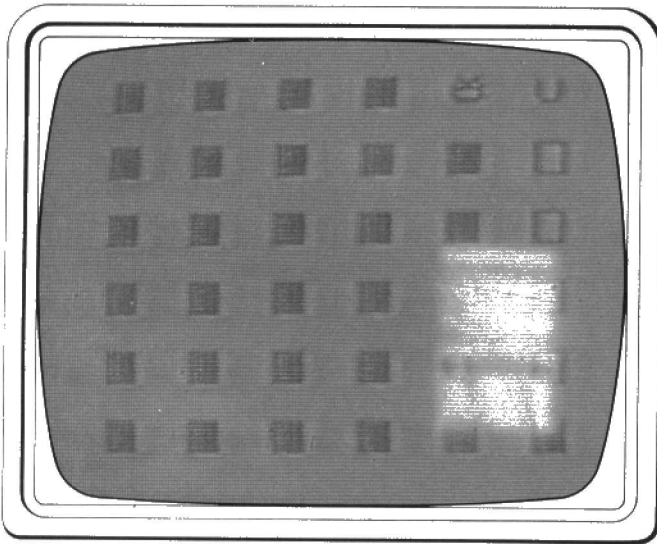
I was a sure sucker for this game, each time taking on a different character. After a while you learn where the pitfalls are and how to avoid them, but there's always a new problem to tackle.

Although there aren't any graphics, the descriptions and use of music at devastating moments make the adventure an interesting game to play. And if you want to continue the action another day you can always save it on tape.

Sandra Grandison

RATING

Lasting appeal	★★★★
Playability	★★★★
Use of machine	★★★★
Overall value	★★★★



PCN ProgramCards

Apple, Spectrum, Dragon and BBC fans have some happy tapping ahead of them this week in ProgramCards. PCN proudly presents a program of character, one for those of a musical bent, and one for space cadets.

Sound investment

Sound to Light, for the Spectrum, from Rupert Goodwins of Plymouth, shows that you don't need drives to disco. With this program all you have to do is put sound input from your hi-fi to the Spectrum's Ear socket and your screen throbs colourfully in time with the music.

We tried it with a range of musical inputs, from Alberto y Los Trios Paranoias to Frank Zappa, and were suitably stage-struck.

A place in Space

Space Dock is for the Dragon 32 and comes from Steve Triner of Stoke. Your mission is to dock your spaceship successfully, which should be useful practice for when Dragon brings out its Rocket Booster peripheral.

Until then you can make do with Space Dock's entertaining sound facilities.

Rodney Scott of Buckie, Aberdeenshire, has produced Dotter for the Apple II and IIe. It's a puzzling game for the deep thinker, so plug your expansion card into your grey matter's logic banks before you try it.

Last but not least we have the second part of A Phillips' character definition utility for the BBC micro. Model A users

PCN Programs Editor

PCN wants you. That is, if you can understand and explain other people's programs, spot a bug in the heart of a listing, have done time on a number of micros running different dialects of Basic and have more than a passing familiarity with Pascal, Forth and other popular languages.

If this sounds like you, write with CV to: Cyndy Miles, Editor, *Personal Computer News*, VNU, Evelyn House, 62 Oxford Street, London W1A 2HG.

will find the necessary line changes along with the first part of the program.

A RUN for our money

We pay for published programs on a sliding scale which take into account length, complexity, originality and the programming skill demonstrated in the program. So why not give us a RUN for our money?

As well as the cash, you receive the satisfaction of seeing your byline on the ProgramCard — which will, of course, be snipped out and filed away in the libraries of thousands of micro enthusiasts throughout the country.

Send your contribution, on disk or cassette, together with a plain paper listing and brief summary notes to:

The Programs Editor, *Personal Computer News*, VNU, 62 Oxford Street, London W1A 2HG.

All disks and cassettes will be returned as soon as possible after evaluation or publication, at our expense.

PCN ProgramCards

Dotter
8322D1/3

Card 1 of 3

```
130 HOME
140 INVERSE : PRINT "
150 SPEED= 150
160 PRINT " D O T T E R . . . . . " ; SPEED= 255
170 PRINT "
180 NORMAL
190 PRINT
200 PRINT "ELIMINATE THE DOTS BY MOVING THE CURSOR"
210 PRINT "OVER THEM. IF YOU HIT THE WALLS YOU CRASH !!!"
220 PRINT "YOU GAIN TWO BONUS MOVES FOR EACH OF THE";
230 PRINT "DOTS ELIMINATED. "; PRINT
240 PRINT "REMEMBER - YOU HAVE A LIMITED NUMBER OF"
250 PRINT "MOVES. THE CONTROL KEYS ARE: -": PRINT
260 PRINT "'I'=UP: 'M'=DOWN: 'J'=LEFT: 'K'=RIGHT."
270 PRINT : PRINT "PRESS ANY KEY TO BEGIN"
280 GET I$: IF I$ = "" THEN 280
290 C = 4: GOTO 320
300 C = 15:
310 IF C = 15 THEN D = 14
320 HOME : GR : POKE - 16301,0
330 SC = 0: COUNT = 0: MO = 210
340 GOSUB 530
350 GOTO 720
360 COLOR= 14
```

Apple II, II+, IIe Applesoft

Application: Game
Author: Rodney Scott

130-180 Inverse title
";

190-280 Instructions

320-330 Set up screen and initial values
340 Perform board/maze routine
350 Jump to random dots routine
360 Set player's colour

PCNProgramCards**Dotter**
8322D2/3**Card 2 of 3**

370 X = 1:Y = 38	370-380	Set player's position
380 PLOT X,Y		
390 GET I\$: IF I\$ = "" THEN GOTO 390	390	Key input statement
400 COLOR= 0: GOSUB 640	400	Perform dot erase and score routine
410 IF I\$ = "M" THEN Y = Y + 1	410-460	Movement loop
420 IF I\$ = "K" THEN X = X + 1		
430 IF I\$ = "I" THEN Y = Y - 1		
440 IF I\$ = "J" THEN X = X - 1		
450 MD = MD - 1		
460 VTAB 22: PRINT "MOVES LEFT ";MD;" SCORE:";SC;" "		
470 IF SC = 50 GOTO 890	470	Check perfect score
480 IF MD < = 0 THEN GOTO 800	480	Check moves left
490 COLOR= 14	490-510	Puts player back on screen and return for next move
500 GOSUB 640		
510 GOTO 390: REM RETURN FOR NEXT MOVE		
520 REM SUBROUTINE FOR DRAWING BOARD		
530 COLOR= C: VLIN 0,39 AT 0	530-630	Routine to draw board/maze
540 VLIN 0,39 AT 39		
550 HLIN 0,39 AT 0		
560 HLIN 0,39 AT 39		
570 HLIN 1,2 AT 32: HLIN 8,32 AT 32: HLIN 1,26 AT 26		
580 HLIN 1,7 AT 20: HLIN 13,33 AT 20: HLIN 6,13 AT 14		
590 HLIN 37,38 AT 14: HLIN 31,33 AT 8: HLIN 8,38 AT 1		
600 VLIN 1,8 AT 6: VLIN 1,8 AT 7		
610 VLIN 8,19 AT 25: VLIN 1,14 AT 19: VLIN 8,19 AT 13		
620 VLIN 9,19 AT 31: VLIN 21,31 AT 32: VLIN 26,38 AT 38		
630 RETURN		
640 REM REMOVES DOT AND GIVES BONUS POINTS		
650 IF SCRN(X,Y) = C THEN 830	650	Check for crash

PCNProgramCards**Dotter**
8322D3/3**Card 3 of 3**

660 IF SCRN(X,Y) = 9 THEN MD = MD + 2	660-700	Routine to remove dot and adjust score. Also left movement
670 IF SCRN(X,Y) = 9 THEN PRINT CHR\$ (7)		
680 IF SCRN(X,Y) = 9 THEN SC = SC + 1		
690 PLOT X,Y		
700 RETURN		
710 REM SUBROUTINE FOR SETTING RANDOM DOTS	710-790	Routine to place random dots on board/maze
720 FOR I = 1 TO 50		
730 YY = RND (40) * 40:XX = RND (40) * 40		
740 IF SCRN(XX,YY) = (C) THEN GOTO 730		
750 IF SCRN(XX,YY) = (9) THEN 730		
760 COLOR= 9		
770 PLOT XX,YY		
780 NEXT I		
790 GOTO 360		
800 LD = 50 - SC	800-820	End of moves routine
810 INVERSE : VTAB (22): PRINT " YOU RAN OUT OF MOVES !!!-";LD;" DOTS LEF T"		
820 NORMAL : GOTO 840		
830 VTAB (22): INVERSE : PRINT " YOU CRASHED !!!": NORMAL	830-840	Message called by crash
840 FOR I = 1 TO 1000: NEXT I		
850 VTAB (23): PRINT "PLAY AGAIN (Y/N)";: INPUT I\$: PRINT " "	850-880	Prompt and response for another game
860 IF I\$ = "Y" THEN GOTO 320		
870 IF I\$ < > "N" THEN 850		
880 TEXT : HOME : END		
890 SC = SC + MD: INVERSE	890-910	Victory message, calls 'new game' routine
900 PRINT " YOU DID IT !!! SCORE:";SC;" "		
910 NORMAL : GOTO 840		

PCNProgramCards

Sound to Light Card 1 of 3

8322SL1/3

Sinclair Spectrum Spectrum Basic

Application: Entertainment

Author: Rupert Goodwins

A clever program generating coloured patterns using the EAR input from tape, incorporating a machine code subroutine.

1 LET size=32500+32768*(PEEK 23733>200)	1-15	Find size of RAM, adjust RAMTOP, set up variables
10 CLEAR size=1		
12 LET size=32500+32768*(PEEK 23733>200)		
13 LET bak=0: LET bor=0: LET pa=0		
15 LET bo=0		
20 FOR f=size TO size+45	20-50	Load machine code routine and define it
30 READ a: POKE f,a		
40 NEXT f		
50 DATA 17,255,3,33,0,88,1,0,3,219,0,0,230,64,137,203,31,79,05,32,-12,119,35,0		
,0,27,175,130,40,2,24,-26,219,0,203,71,200,58,120,92,230,7,211,254,24,-46		
100 REM LD DE,959	100-221	REMs show Z80 code for the routine. Z80 programmers should follow this easily.
110 REM LD HL,22528		Others can ignore it, or learn from it.
120 REM LD BC,0007		
130 REM IN A,0		
140 REM CPL/nop		
150 REM AND 64		
160 REM ADD A,C		
170 REM RRA		
180 REM LD C,A		
190 REM DEC B		
200 REM JRNZ -12		
210 REM LD (HL),A		
220 REM INC HL		
221 REM NOP		

PCNProgramCards

Sound to Light Card 2 of 3

8322SL2/3

222 REM NOP	222-280	Remainder of machine code
230 REM DEC DE		
240 REM XOR A		
250 REM ADD A,D		
260 REM JRZ 2		
270 REM JR -23		
271 REM IN A,0		
272 REM BIT 0,A		
273 REM RETZ		
274 REM LD A,(23672)		
275 REM AND 7/and 0		
278 REM OUT 254,A		
279 REM JR -41		
280 REM All absolutes in	DECIMAL!!!	
285 GO SUB 3000: CLS	285	Goes to initial page
290 RANDOMIZE USR size	290	Call the routine
1000 CLS	1000-1160	Present options and accept input
1010 PRINT "Sound to light"		
1020 PRINT ""Options:"		
1030 PRINT ""B""=Multicoloured border""L""=Black border"		
1040 PRINT ""W""=White background""D""=Dark background"		
1050 PRINT ""P""=Patterned background""O""=Ordinary background"		
1060 PRINT ""Press the buttons you want, followed by ENTER"		
1100 IF INKEY\$="p" THEN BEEP .05,18: LET pa=1		
1110 IF INKEY\$="l" THEN BEEP .05,7: LET bor=0		
1120 IF INKEY\$="b" THEN BEEP .05,30: LET bor=7		
1130 IF INKEY\$="w" THEN BEEP .05,10: LET bak=47		
1140 IF INKEY\$="d" THEN BEEP .05,15: LET bak=0		
1150 IF INKEY\$="o" THEN BEEP .05,20: LET pa=0		
1160 IF CODE INKEY\$=13 THEN BEEP .05,25: GO TO 1200		

PCNProgramCards

Sound to Light Card 3 of 3

8322SL3/3

1170 GO TO 1100	1170-1230	Remainder of options
1200 POKE size+11,bak		
1210 POKE size+41,bor		
1215 CLS		
1220 IF pa THEN GO SUB 2890		
1230 GO TO 290		
2000 STOP		
2890 FOR f=5 TO 50 STEP 10: CIRCLE 70,60,f: CIRCLE 140,110,f: PLOT 100,50: DRAW f,70: NEXT f	2890	Draw background pattern if required
2900 RETURN		
3000 REM >>>>>Instructions	3000-3140	Instructions
3010 BRIGHT 1: PAPER 0: BORDER 0: INK 7: CLS		
3020 PRINT "*****"		
3030 PRINT "***ZX Spectrum Sound to light***"		
3040 PRINT "*****"		
3050 PRINT		
3060 PRINT		
3070 PRINT "Connect the EAR socket to a source of sound,like a cassette recorder or across a loudspeaker"		
3080 PRINT		
3090 PRINT "Be carefull not to exceed about 2 watts in."		
3100 PRINT "Adjust the volume and tone controls for the most pleasing picture."		
3110 PRINT		
3120 PRINT "To alter the mode of operation press ""CAPS SHIFT"" which will return you to the options screen"		
3130 PRINT "Press any button to GO!!!"		
3140 PAUSE 0: RETURN		

PCNProgramCards

Space Dock Card 1 of 3

8322SD1/3

Dragon 32 Dragon Basic

Application: Game
Author: Stephen Triner

A short hand/eye co-ordination game with sound.

10 CLS	10-20	Clear screen and play theme tune
20 PLAY"T20;02L4G6;L26DL4BB;L2BGL4GB;03L2DDL4C02B;A"		
40 PRINT:PRINT" NEED INSTRUCTIONS(Y/N)":INPUTZ\$:IFZ\$="N"THENGOTO70ELSEGOTO50		
50 CLS:PRINT:PRINT"THE OBJECT OF THE GAME IS TO LAND THE SPACE SHIP ON THE LINE USING 'Q' TO THRUST UP AND 'A'TO THRUST DOWN.GOOD LUCK!":SOUND9,9:FORI=1TO5000:NEXTI	40-50	Prompt and response for instructions
60 REM SET UP SPACE SHIP		
70 DIML(9,9)	70-90	DIM arrays to hold spaceship graphics
80 DIMA\$(9)		
90 DIMC(9,9)		
100 A\$(1)="00011000"	100-160	Graphics strings for spaceship
110 A\$(2)="00111100"		
120 A\$(3)="00111100"		
130 A\$(4)="01111110"		
140 A\$(5)="01011010"		
150 A\$(6)="01000010"		
160 A\$(7)="01000010"		

PCNProgramCards**Space Dock****Card 2 of 3**

8322SD2/3

170 A\$(8)="01000010"	170	Final graphic string for spaceship
180 PMODE4,1:PCLS	180-220	Define the spaceship
190 FORX=1TO8:FORY=1TO8		
200 K=0:IFMID\$(A\$(X),Y,1)="1"THENK=1		
210 PSET(9+Y,9+X,K)		
220 NEXT:NEXT		
230 GET(10,10)-(18,18),C	230	Places spaceship graphic in graphics memory array
240 PCLS	240-310	Set up the screen display
250 SCREEN1,1		
260 CIRCLE(209,32),15,5:PAINT(208,33),5,5		
270 LINE(0,155)-(15,170),PSET,BF		
280 LINE(255,165)-(205,170),PSET,BF		
290 LINE(99,171)-(109,171),PSET,BF		
300 LINE(0,145)-(10,155),PSET,BF		
310 LINE(255,155)-(215,165),PSET,BF		
320 A=1500	320-350	Initialise Altitude, Thrust, Fuel and Velocity variables
330 TH=0		
340 F=20		
350 V=0		
360 FORZ=1TO10:FORO=1TO10:O=RND(255)-1:W=RND(152)-1:PSET(O+Z,W+O,5):NEXT:NEXT	360	Draw stars in background
370 REM THE DECENT	370	Main program loop
380 J=1509-A:K=J+8	380-390	Place spaceship on screen using memory array defined in line 230
390 PUT(110,J)-(118,K),C		

PCNProgramCards**Space Dock****Card 3 of 3**

8322SD3/3

400 PUT(110,J)-(118,K),L	400-410	End of routine to position spaceship
410 LINE(0,170)-(255,170),PSET,BF		
420 A\$=INKEY\$	420-440	Get command from keyboard
430 IFA\$="Q"THENH=TH-1		
440 IFA\$="A"THENH=TH+1		
450 REM DID IT CRASH	450-500	Adjust variables and check position
460 V=V+TH/5		
470 IFV<0THEN490		
480 A=A-V		
490 F=F-TH/10		
500 IFF<0ORA<1350THENGOTO520		
510 GOTO380		
520 CLS:IFV<5ANDF>0THENGOTO570	520	Check for safe landing
530 PRINT"YOU CRASHED WITH FUEL ";F	530-560	Crash routine
540 PRINT"AND AT A SPEED OF ";V		
550 PLAY"T2;A;C;D;F;A;B;G"		
560 PRINT"WOULD YOU LIKE ANOTHER GO Y/N";:INPUTM\$:IFM\$="Y"THEN GOTO 180ELSEEND		
570 FORI=1TO150:NEXTI:PRINT"YIPEE YOU'VE LANDED!!!"		
580 PRINT"WITH FUEL ";F	570-610	Safe landing. Consider yourself promoted
590 PRINT"AND A SPEED OF ";V		
600 PLAY"T15;A;B;C;D;E;F;G"		
610 PRINT"WOULD YOU LIKE ANOTHER GO Y/N";:INPUTN\$:IFN\$="Y"THENGOTO180ELSEEND		


```

800 DEFPROCinput
810 REPEAT
820   Valid%=TRUE
830   Inp#:=FNinput
840   IF Inp#="" GOTO870
850   S:=(INSTR(SCord$,Inp#)+1)/2
860   IF S=0 OR S=INT(S)=0.5 PROCInv
870   UNTIL Valid%
880   IF Inp#="" ENDPROC
890 PROCfill(X1%(S),X2%(S),Y1%(S),Y2%(S))
900 PROCvalue
910 PROCchar(Tot%(1),Tot%(2),Tot%(3),Tot%(4),Tot%(5),Tot%(6),Tot%(7),Tot%(8))
920 ENDPROC
930 ::::::::::::::::::::::::::::::
940 DEFPROCnew
950 FORI%=1TO8:Tot%(I)=0:NEXI%
960 H%=1:J%=0
970 FORI%=224TO255
980   IF I%>239 THEN H%=11
990   PRINTTAB(H%,J%)YEL#:"CHR "I%" "WHI#;CHR#I%
1000  J%=J%+2:IF J%>31 THEN J%=0
1010  NEXTI%
1020 PRINTTAB(0,31)WHI#:"SPACE>Next S>Save";
1030 REPEAT:G%=GET AND 223:UNTIL G%=0 OR G%=83
1040 IF G%=83 ENDPROC
1050 C%=C%+1:IF C%>255 THEN C%=224
1060 VDU5
1070 ENDPROC
1080 ::::::::::::::::::::::::::::::
1090 DEFPROCInv
1100 Valid%=FALSE
1110 PRINTTAB(2,30)SPC(19):PRINTTAB(2,30)RED#;" INVALID ENTRY"
1120 VDU7:FOR X=1TO1000:NEXTX
1130 ENDPROC
1140 ::::::::::::::::::::::::::::::

```

800-920 Procedure to verify data input.

940-1070 Procedure to display the complete character set.

1090-1130 Procedure to flag an invalid entry.

```

1150 DEFPROCfill(X1,X2,Y1,Y2)
1160 Del%=FALSE
1170 GCOL0,1
1180 IF POINT(X1,Y1)=1 THEN Plot%=87:Del%=TRUE ELSE Plot%=85
1190 MOVEX1,Y1:MOVEX2,Y1
1200 PLOTPlot%,X1,Y2:PLOTPlot%,X2,Y2
1210 ENDPROC
1220 ::::::::::::::::::::::::::::::
1230 DEFPROCvalue
1240 Value%=2^(8-(INSTR(G$,LEFT$(Inp%,1))))
1250 IF Del% THEN Value%=-Value%
1260 Pos%=VAL(RIGHT$(Inp%,1))
1270 Tot%(Pos%)=Tot%(Pos%)+Value%
1280 PRINTTAB(31,VY%(Pos%))SPC(3):TAB(31,VY%(Pos%))WHI#;STR$(Tot%(Pos%))
1290 ENDPROC
1300 ::::::::::::::::::::::::::::::
1310 DEFPROCchar(a,b,c,d,e,f,g,h)
1320 VDU23,C%,a,b,c,d,e,f,g,h
1330 PRINTTAB(37,16)WHI#;CHR#C%
1340 ENDPROC
1350 ::::::::::::::::::::::::::::::
1360 DEFENinput
1370 LX=0:Input#=""
1380 PRINTTAB(2,30)SPC(19):TAB(2,30)WHI#;"SELECT A SQUARE:";
1390 Ccode=GET
1400 IF Ccode=32 THEN Input#:=CHR$(Ccode):GOTO1510
1410 IF Ccode>96 AND Ccode<123 THEN Ccode=Ccode-32
1420 IF Ccode=13 AND LX<2 GOTO1390
1430 IF Ccode=13 GOTO1510
1440 IF Ccode=127 AND LX=0 GOTO1390
1450 IF Ccode=127 THEN LX=LX+1:Input#:=LEFT$(Input#,LX):GOTO1500
1460 IF Ccode<49 OR Ccode>72 GOTO1390
1470 IF Ccode<56 AND Ccode<65 GOTO1390
1480 IF LX=2 GOTO1390
1490 LX=LX+1:Input#:=Input#+CHR$(Ccode)
1500 PRINT YEL#*CHR$(Ccode):GOTO1390
1510 Input#

```

1150-1210 Procedure to fill in a square on the grid.

1230-1290 Procedure to show the value of the bits entered so far.

1310-1340 Procedure to display newly defined character.

1360-End Procedure to accept a key input, check it and set up variables to indicate status to program.

Clubnet keeps you in touch with enthusiasts throughout the UK. It is divided into clubs and user groups. We publish a list of these groups on alternate weeks. This week clubs are listed alphabetically by county and town. Each week we focus on an individual club or group with a fly-on-the-wall report. If your

association has something special on the agenda or if you've just started a new one, contact us at *Clubnet, Personal Computer News*, VNU, 62 Oxford Street, London W1A 2HG.

The clubs listing is based on that of the Association of Computer Clubs.

Sub-groups on-line

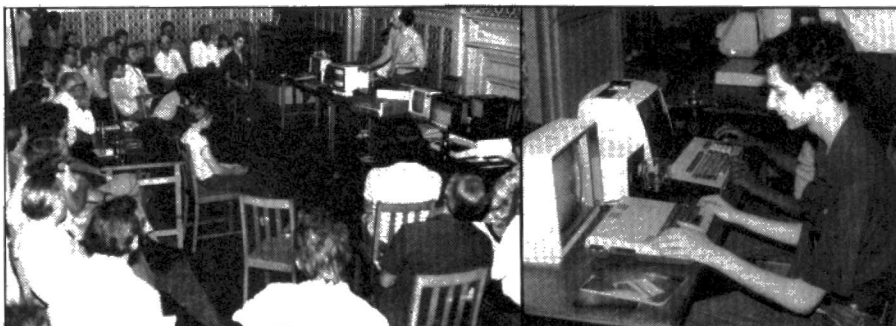
Long, cool pints were being downed by 40 or so members of the West London Personal Computer Club at the meeting I attended in the Fox and Goose, Hanger Lane, London W5.

Seven members gave demonstrations of their machines in a 45-minute session compered by Neil Cryer, a founder member and micro author. The equipment ranged from a ZX81 to a multi-board system and Torch Z80 disk drives.

Membership of this 4½-year-old club has taken a turn for the better now that meetings are held once again at the Fox and Goose. Members met for a while at the local Poly, and while that had far more facilities it didn't have the pints, and membership dwindled. There are now 70 members and it's still growing.

The club is not only blooming but actually sprouting plenty of enthusiastic sub-groups. For instance, the BBC Group has now outgrown members' sitting rooms, and that too meets in the pub.

Treasurer Graham Brain, also a founder-member, is a little anxious lest the sub-groups lose touch with the club. To this end, the CP/M Group's first project is designed to be available to all club



West London PCC founder Neil Cryer presides over a demo session (left). Programs by the pint (right).

members who have a micro, a phone and £30.

Mr Brain explained: 'We want to develop a CP/M machine which, if members have a £30 300-baud modem, they can use it to get access to club news and events.'

He has similar hopes for the club's intended involvement with the new Brent Information Technology Centre, which opens in September at nearby Stonebridge.

This is being eagerly anticipated by the new Hardware Group, which will be able to get at more exotic pieces of equipment such as oscilloscopes and test equipment.

It came as no surprise to learn that Information Technology Exchange Centres will be the subject of September's talk at the joint meeting with the British Computer Society from Greenford.

Other meetings in the near future will cover programming principles, Z80, Rewtel and assembly language programming.

Harriet Arnold

Name West London Personal Computer Club
Venue Fox & Goose, Hanger Lane, London, W5
Meetings First Tuesday of each month at 7.45pm
Contact Graham Brain, 01-997 8986, or Neil Cryer, 01-997 9437.

CLUBS

AVON

Bristol Bensley Nuclear Laboratories Club. Contact Neil Walker, 53 Wolfridge Ride, Alveston, Bristol, 0454 414262.

Bristol Micro Computer Club. Meets at the Pavilion, Southend Road, Filton, Bristol, every other Tuesday. Darryl Collins, 60 Mackie Rd, Filton, Bristol BS12 7NA, 0272 792982.

Bristol Format 40/80 Disc Club, for BBC disk users. Contact Peter Hughes, Format 40/80 Disc Club, c/o The Lending Library, Five Marshal Street, Bristol BS1 4AA.

Multi-User Club Valerie Boyde-Shaw, Nailsea 851337.

Worce Computer Club. Meets at Woodsprings Inn Functions Rooms on alternate Mondays at 7-10.30pm. H Bennett, 0934 514902 or F Feeney, 0934 833122.

BEDFORDSHIRE

Bedford Amateur Computer Club. Meets at Star Rowing Club, Bedford, on the first and third Tuesday of month 8pm. Rowan Bird, 74 High Street, Great Barford, MK44 3LB, 0234 870763.

Chiltern Computer Club. Meets at Five Bells, Eaton Bray, Near Dunstable, Leighton Buzzard on second and fourth Monday of each month. Contact Steve Betts, 42 Wallace Road, Eaton Bray, OU6 2DF, 0525 220922.

Luton College Computer Club. John Rodger, 0582 3411.

Luton Computer Club. J P Fletcher, 1 Trowbridge Gardens, Luton, LU2 7JY, 0582 450687.

BERKSHIRE

Easthampstead Computer Club. Meets at

Easthampstead Park School, Bracknell, on the first Wednesday in month at 8pm. Brian Poulton, 0344 84423.

BIRMINGHAM

Birmingham Amateur Computer Club. Meets at CBS Consultants, Watery Lane, Small Heath, Birmingham 10, on the first and third Wednesday of each month at 7pm. Contact Dr M Bayliss, 125 Berryfield Road, Sheldon, B26 3UU, 021743 7197.

BUCKINGHAMSHIRE

Aylesbury Computer Club. Meets at Quarrendon Youth Club every Friday at 7.30pm and at Mandsville County Secondary School the first Thursday of each month at 7pm. Ken Knight, 22 Mount Street, Aylesbury, 0296 5181.

Chiltern Microcomputer Club. Meets at the Garden Centre, School Lane, Chalfont St Giles, on the first Wednesday of each month. Mrs W Tibbitts, Ellwood, Deanway, Chalfont St Giles. 024 07 4906.

Iver Computer Club. P A Seal, 1 Ormonde Flats, Church Road, Iver Heath, 0753 652792.

Iver Computer Society meets at Huntsmoor room, Iver Village Hall on the second and fourth Thursday every month at 7.30. John Haigh, 141 Leas Drive, Iver, SL0 9RP.

CAMBRIDGE

Cambridge Microcomputer Club, meets on the third Wednesday of month. Derek Tripp, 3 Spurgeons Avenue, Waterbeach. 0223 315662.

Haverhill Microcomputer Club, meets at St Marys' Church Hall, Camps Road, Haverhill, on the second, third and fourth Wednesday of month at 7.30 to 10.30pm. Andrew Holliman, 5 Trinity Close, Balsham, CB1 6DW, 022 029 583.

Peterborough Personal Computer Club meets at Crosfield Electronics Social Club,

fortnightly on Mondays. Andrew Pike, 0733 44342 after 5pm.

CHESHIRE

Altrincham Computer Club. Meets at N. Cestrian Grammar School, Durham Road, Altrincham, fortnightly. Martin Hickling, 39 Barrington Road, Altrincham, WA14 1H2, 061 941 4547.

Brunel Computer Club. Meets at St Werburgh Community Centre on alternate Wednesdays at 7 to 10pm. Mr R Simpson, 4 The Coots, Stockwood.

Cheshire Computer Club. Contact W Collins, 37 Garden Lane, Chester, Cheshire.

Crewe Computer Users Club meets at Buffaloes Club, Earl Street, Crewe, on the third Thursday of each month at 8pm. Bram Knight, 0270 623375.

Holmes Chapel Micro Club meets at Leisure Centre, Holmes Chapel at 7.30 to 9.30pm on the first and third Tuesday of month. Margaret Baker, 1 Helton Close, Crewe. 0477 34238.

Kinder Peck Computer Club meets at Bew Mills School every Monday. John Eary, New Mills 43870.

Kettleshulme National Computer Buyer's Club. Send SAE to Barry Edwards, Laneside House, Paddock Lane, Kettleshulme, nr Stockport, Cheshire.

New Mills & District PCC meets at New Mills School, fortnightly on Fridays at 7 to 9.30pm. Mr G M Flanagan, 11 Sundown Close, New Mills, Stockport, SK12 3DH, 0663 44051.

Northwest Computer Club meets fortnightly. John Lightfoot, 13 Aston Drive, Frodsham, Warrington, WA6 7PU. 0728 31519.

Northwest Computer Club, weekly meetings. Tom Wyatt, 29 Summer Lane,

Halton, Runcorn Cheshire WA7 5PG. Runcorn 77545.

Mid-Cheshire Computer Club meets at Winsford Library on the second Friday every month at 7.30pm. Simon Sadler, Winsford 53339.

Stockport Software Exchange Club. Send SAE to P Redford, 53 Cavendish Road, Hazel Grove, Stockport, Cheshire.

CLEVELAND

Cleveland Micro Club meets on the second and third Tuesday of each month, under 18s on second of month, over 21s on third Tuesday of month. J Telford, 13 Weston Crescent, Norton.

Stockton Amateur Computer Club meets at YMCA, Stockton, each alternate week at 7-9pm. Peter Cheshire, 60 Croft Road, Eaglescliffe, Stockton-on-Tees, TS16 0DY.

CORNWALL

Cornish Radio Amateur Club — Computing Section. Bob Reason, 24 Mitchell Road, Camborne.

Cornwall Area PAICC meets at the Penzance Micro Centre every Friday. S Zenith. Hayle 754845.

St Austell Computer Club and Computer Town meets at ECIP Labs, Penpewar Road, fortnightly on Mondays at 7.30pm. N G Day, 2 Cilendale Close, St Austell.

CUMBRIA

Ambleside Computer Club. Contact Jeremy Westerman, 8 Hill Top Road, Ambleside, Cumbria. Tel: Ambleside 2452.

DERBYSHIRE

Derby Micro Society meets at Littleover Church Hall, Sheperd Street, on every other Thursday at 7pm. Mike Riordan, 0332 769440.

Glossop Computer Club. John Dearn, 2 Spinney Close, Glossop.

DEVON

Brixham Computer Users Club. Meets at Computer Systems (Torbay), Pump Street, Brixham, Saturdays at 2.30pm. Ian Chipperfield, 22 Brookdale Court, Brixham, Devon (Brixham 59224).

Exeter & District Computer Club meets at Exeter School, Magdalen Road, Exeter, on the second and fourth Tuesday every month. T G Holden, 14 Greenville Avenue, Teignmouth, TQ14 9NT.

Exeter & District Amateur Computer Club meets at Crestwood Centre, Stoke Cannon, Exeter. Specialist meetings on third and fourth Tuesday.

Okehampton Computer Club. Contact Cherri Graebe, Okehampton 3523, or Okehampton Community College, Okehampton 3800. Meets 7pm each Monday during term time.

Torbay Users Computer Club meets at Devon Computers, 39 Totnes Road, Paignton on Mondays fortnightly.

DORSET

Bournemouth Area Computer Club meets at Kinson Community Centre on the third Wednesday every month. Peter Hibbs, 54 Runnymede Avenue, Bournemouth, BH11 9SE. 0202 576547.

TOPIC meets at Canteen English Truck Centre on the second and fourth Wednesday every month at 7pm. David Washford, 1 Alexander Road, Bournemouth, BH6 5JA.

Purbeck Computer Club, contact 31 North Street, Wareham, Dorset BH20 1AD.

DURHAM

Darlington Computer Club, weekly meetings. L Boxell, 8 Vane Terrace, Darlington DL3 7AT. 0325 67766.

ESSEX

Genius Computer Club. 30 Webber House, North Street, Barking.

Great Dunmow Computer Club. Contact T Coombs, 4 Oakroyal House, Oakroyal Avenue, Great Dunmow, Essex CM6 1HQ.

Brentwood Amateur Computer Club, meets once a month. R Sadler, 18 Warescot Road, Brentwood, CM15 9HD. Brentwood 232463.

Springfield Computer Club meets on the first Friday of every month. Stephen Cousines, 1 Aldeburgh Way, Springfield, Chelmsford, CM1 5PB. 0245 50155.

Canvey Computer Club. Contact Dean Williams, 17 Mornington Road, Canvey Island, Essex SS8 8AT.

Colchester Microprocessor Group meets at University of Essex on the second and fourth Wednesday of every month at 7.30pm. Information Centre, University of Essex, near Colchester.

Colchester Computer Society. Meets at Severalls Hospital Social Club, Colchester. Contact A Potten, 14 Foxmead, Rivenhall, Witham, Essex CM8 3HD, Witham 516335.

Stanway School Computing Club, only school members at present. G Floyd, c/o Physics Department, Stanway School, Stanway, Colchester.

Nailsea Multi-User Club. Contact Valerie Boyde-Shaw, 0272 851337.

Romford Club, a new club. Mr D Norden, 138c Church Road, Romford.

Roundacre Micro Computer Users Club. Meets at the Roundacre Youth House, Laindon Link, Basildon every Wednesday at 7.30pm. Contact Mrs L Daden, Basildon 285119.

South East Essex Computer Society meets at Hockey Club at Roots Hall, near Southend Football Stadium on Wednesday at 7.30pm. Robin Knight, 128 Little Wakering Road, Little Wakering, Southend-on-Sea. 0702 218456.

GLOUCESTERSHIRE

British Amateur Electronics Club. Mr J Margetts, 3 Bishopstone Close, Golden Valley, Cheltenham.

Cheltenham Amateur Computer Club meets on the third Tuesday of each month at 7.30pm. Mike Pullin 0242 25617 or Robin Phelps 0242 584343.

GCHQ, D W Adam, 16 Court Road, Prestbury, Cheltenham.

Cheltenham Amateur Computer Club meets at Prestbury Scout Headquarters, on the third Tuesday of every month at 7.30pm. M Hughes, 36 Riverviews Way, Cheltenham.

HAMPSHIRE

Commodore Computer Club. Meets on the first Friday of every month at Bury House, Bury Road, Gosport at 7.30pm. Brian Cox, Fareham 280530.

Fareham and Portsmouth Amateur Computer Club. Alan Smith, c/o Francis Close, Lee-on-the-Solent, Gosport, Hants PO13 8HB. 0705 550907.

RAF Odiham Computer Club. Contact c/o Officer i/c, Royal Air Force, Odiham, Nr Basingstoke, Hants.

Southampton Amateur Computer Club meets at Crestwood Centre, Shakespeare Road, Boyatt Wood, Eastleigh, Hants. on the second Wednesday of every month at 7.30pm. Paul Blitz, Chandlers Ford 69050.

HEREFORD

Hereford Amateur Computer Club, proposed new club. Stuart Edinborough, 2 Warwick Walk, Bobblestock, HR4 9TG. 0432 269700.

HUMBERSIDE

Bridlington Microcomputer Club. Meets 7.30pm alternate Fridays at Old Star Inn, High Street, Bridlington. Contact D Compleman, 0262-601859.

Grimsby Computer Club meets at Grimsby Central Library fortnightly on Mondays at 7.30pm. Jensen Lee, 29 Park View, Cleethorpes. 0472 4259.

Scunthorpe & District Microprocessor Society meets at Community Centre, Lindun Street, Scunthorpe, every Tuesday at 7.30pm. G Hinch, 21 Old Crosby, Scunthorpe, South Humberside DN15 8PU.

KENT

Canterbury ACC proposed new club. Contact L Fisher, 21 Manwood Avenue, St Stephens, Canterbury, CT2 7AH.

Gravesend Computer Club. Meets at School Room Extra Tuition Centre, 39 The Terrace, Gravesend. Contact c/o The Extra Tuition Centre, 0474 50677.

Medway Amateur Computer & Robotics Organisation. Meets at 7.30pm on first Tuesday and third Wednesday of every month. Annual subs £5. Contact Paul Cameron, Unit 3, Walderslade Centre, Walderslade Road, Chatham, Kent, 0634-63036.

North Kent Amateur Computer Club meets at Lecture Theatre, Charles Darwin School, Jail Lane, Biggin Hill, on the first Thursday of every month at 7.30pm. Iain House, 28 Canadian Avenue, Catford SE6 3AS. 01-690 5441.

Orpington Computer Club meets at The Large Hall, Christ Church, Chaterhouse Road, Orpington, every Friday at 8pm-10.30pm. Mr R Pyatt, 23 Arundel Drive, Orpington, Kent BR6 9JF. Orpington 20281.

Amateur Computer Club. Rupert Steele, St John's College, Oxford OX1 3JP.

National Personal Computer User Association. Eric Keeley, 11 Spratling Street, Manston, Ramsgate, Kent.

Sevenoaks School Computer Club. G Sommerhoff, Technical Centre, Sevenoaks School, Sevenoaks, Kent. 0732 456340.

Tonbridge & Tunbridge Wells ACC. Ray Szatkowski, 1 Cromer Street, Tonbridge. 0732 355960.

LANCASHIRE

Blackburn Micro Computer Club. Roger Longworth, 12 Sharp Close, Accrington.

Bolton Computer Club meets at E4/24 Bolton Institute of Higher Education, Deane Road, Bolton, on Thursdays. David Atherton, 16 Douglas Street, Asherton, Manchester M29 9FB. 0942 876210.

Burnley Computer Club. Meets at Burnley Technical College on Tuesdays, 7.30-11pm. Contact Clive Tallon, 27 Basnett Street, Burnley, Lancs.

Chorley Computer Club meets at Townley Arms, Chorley, every other Tuesday at 8pm. Tony Higson, 23 Brock Road, Chorley, Lancs. Chorley 68429.

Ribble Valley Computer Club meets at Staff Canteen, Pendle Carpets Ltd, West Bradford, on the second and fourth Monday of month at 7-9pm. Contact Ian Thornton-Bryar, 25 Southfield Drive, West Bradford, Clitheroe, BB7 4TU.

Lancaster & Morecambe Computer Club. Sarah Blackler. 0524 33553.

South Chadderton Computer Club meets at Turf Lane Centre, Turf Lane, Chadderton, on Thursdays at 7-9.30pm. Mr Jakeman, 26 Marble Street, Derker, Oldham. 061-678 0547.

LEICESTERSHIRE

East Leake Computer Club. Andrew Jones, 59 Bateman Road, East Leake, Loughborough, LE12 6NN.

Hawker Siddley Computer Club. Contact R Wrathall, 6 Naseby Drive, Loughborough LE11 0WU.

LINCOLNSHIRE

Lincoln Computer Club, meets at Blandings Public House, High Street, Lincoln on the first and third Wednesday of every month. John Clifford, 448 Newark Road, Lincoln LN6 8RX. 0522 2168.

Skegness Computer Club, meets at County Hotel every other Monday, 7.30-9.30pm. Reg Pottier, 118 Beresford Avenue, Skegness. 0754 3594.

LIVERPOOL

BBC Microgroup Liverpool meets at Old Swan Technical College, Liverpool, on the first Wednesday of month. Nick Kelly, 56 Queens Drive, Walton, L4 6SH.

LONDON

Croydon Computer Club. BBC group meets 7pm, first and fourth Tuesday of each month at Croydon Central Library. Contact Mr Khabaza, 10 Lawrence Road, South Norwood, London, SE25, 01-653 3207.

Computer Users Club. Tony Latham 01-304 3910.

East London Amateur Computer Club meets at Harrow Green Library, Cathall Road, E11, on the second and fourth Tuesday of month at 7-10pm. Fred Linger on 01-554 3288.

Forum-80 London. Leon Jay. 01-286 6207.

Forum-80 Wembley. Victor Saleh, 01-902 2546.

Harrow Computer Group meets at Harrow College of Higher Education, Room W24, Northwick Park, on alternate Wednesday at 7pm. Bazyle Butcher, 01-950 7068.

Imperial College Microcomputer Club meets at room 145, level 1, on Tuesdays at 7.30pm. Tim Pantom, c/o I.C. Union Office, Prince Consort Road, London SW7 2BB.

London School Computer Club. Burlington Dances School, Dane Building, DuCane Road, Hammersmith.

Metropolitan Police Amateur Computing Club meets on the first Thursday of month at 7pm. S Farley, 01-725 2428.

68 Microgroup meets at Regents Park Library, Robert Street, NW1, on the third Tuesday of month at 7.30pm. Jim Anderson, 41 Pebworth Road, Harrow, Middlesex.

North London Hobby Computer Club meets at the Polytechnic of North London, Holloway, N7 8DB, on Monday, Tuesday, Wednesday and Thursday during term time and one evening a week during holidays. Robin Bradbeer, 01-607 2789.

Paddington Computer Club meets at Paddington College, 25 Paddington Green, W2 1NB. Peter Hill, 01-723 5762.

Post Office HQ Microcomputer Club meets at room B145, River Plate House, 12-13 South Place, off Moorgate, on the second Thursday of month. Vernon Quaintance, British Telecom Enterprises, Cheapside House, 138 Cheapside EC2U 6JH. 01-726 4716.

Queens Crescent Computer Club. Meets at Queens Crescent Library, 165 Queens Crescent, London NW5, 01-485 4551.

The SOBAT Computer Club meets once a fortnight. Mr T Kayani, Berridge House, Hillfield Road, NW6.

South East London Microcomputer Club meets at Thames Polytechnic, Greens Ends, Woolwich SE18, on alternate Wednesdays at 7pm. Peter Philipps, 61 Grainger Road, SE3. 01-853 5829.

Southgate Microcomputer Club meets at Room B106 Southgate Tech, fortnightly on Thursdays at 7.30pm. Kevin Pretorius 01-882 2282. See Prestel page 25820645.

West London Personal Computer Club meets at Back room, Fox & Goose pub, Hanger Lane, Alperton, on the first Tuesday of month at 7.45pm. Graham Brain, 01-997 8986.

MANCHESTER

Manchester Computer Club meets at the Department of Computer Science, Manchester University, Oxford Road, on the first and third Thursday of month at 7.30pm. David Wade, 061-941 2486.

Small Business Computer Users Club. Proposed new club to meet the last Tuesday of month. K Wadsworth, 061-740 7232 after 5pm.

South Trafford Microcomputer Club. Meets fortnightly. Contact Ian White, 16 Leicester Avenue, Timperley, Altrincham WA15 6HR, 061-969 2080.

MERSEYSIDE

Merseyside Microcomputer Group meets at Merchant Taylor's School, Crosby, on second Thursday month. Mr F Shaw, 14 Albany Avenue, Eccleston Park, Prescot. 051-426 5536.

Southport Computer Club meets weekly. Ian Bristone, 28 Weld Road, Southport, Merseyside PR8 2DL. 0704 64524.

Wirral Microcomputer Users Group meets at Birkenhead Technical College every Monday. J Phillips, 14 Helton Close, Birkenhead, Merseyside L43 9HP.

Wirral Computer Club. Contact Gary Metcalfe, 24 Marlston Avenue, Irby, Merseyside.

MIDDLESEX

Brigadier Computer Club. Meets on the first and third Monday of every month at Brigadier Youth Centre, Brigadier Hill, Enfield at 7.30 pm. Subs: £2. Contact Steve Ward, 28 Brodie Road, Enfield, Middx EN2 0EU, 01-363 3786.

Micromodeller User Association. Meets three times a year. Contact Phillip Matthews, Phillip Morris House, 21 High Street, Feltham TW13 4AD, 01-751 6388.

Sunbury Computer Club meets at St Benedicts Hall, Napier Road, Ashford, on the last Tuesday of month at 8pm. Simon Taylor, 8 Priory Close, Sunbury-on-Thames, Middlesex. Simon Clark, 83 Watling Street, Towcester, Northants NW12 7AG.

ZX Micro Club. Contact Paul Hargreaves, 10 The Ride, Brentford, Middx.

NORTHAMPTONSHIRE

Corby Universal Micro Club. Meets at Lodge Park Sports Centre fortnightly on alternate Wednesdays and Thursdays. Contact Peter Wilson, 26 North Cape Walk, Corby, tel: Great Oakley 742622.

NOTTINGHAMSHIRE

Ashfield Computer Club meets at Carsic Junior School, St Mary's Road, Sutton in Ashfield on the first and third Thursday month. Derick Daines, c/o Cuttings Avenue, Sutton in Ashfield, Notts.

Eastwood Town Micro Computer Club meets at Devonshire Drive Junior School Wednesday at 5.45pm. Ted Ryan, 15 Queens Square, Eastwood, Nottingham NQ16 3BJ.

Nottingham Microcomputer Club meets at Castle Gate Centre, Nottingham, Monday at 7.30pm. Mr E Harvey, 68 Roseleigh Avenue, Nottingham NG3 6FH. Nottingham 608491.

Workshop Computer Group. New club, first meeting June 14 in Workshop library lecture room. Mr Andrews, Workshop 487327.

NORFOLK

Anglia Computer User Group. Jan Reiji, 128 Templemere, Sprowton Road, Norwich. 0603-29652.

Brecklands Computer Club. Contact Andrew Hiom, 11 Annafewes Close, Thetford, Norfolk. Meets each Saturday, 5pm at this address.

Dereham & District Computer Club. Meets at Middle School, Westfield Road, Toftwood, East Dereham on every second Wednesday at 7.30pm. Contact Mrs Fran Cook, Dereham 67732.

East Anglian Computer User's Group meets at Crome Community Centre, Telegraph Lane, Norwich. Gill Rijzi, 88 St Benedicts, Norwich.

South Northants Computer Group meets at Anchor House, Moat Lane, Towcester, on Wednesdays at 7.30pm.

OXFORDSHIRE

Association of Computer Clubs. Rupert Steele, St John's College, Oxford OX1 3JP.

Microsoc meets at Clarendon Lab, Parks Road, Oxford, every week during term. Rupert Steele, St John's College, Oxford OX1 3JP.

Oxford Personal Computer Club. Len Phelps, Southport Cottage, Sutton Courtenay, Nr Abingdon, Oxon OX14 4AU.

Ridgeway Computing Club meets at Swan Hotel, East Ilsley, on the second Tuesday month. Mike Magney, Beavers, South Street, Blubury, Didcot, Oxon OX11 0JU.

SHROPSHIRE

Ludlow & District Microcomputer Club meets at Diocesan Education Centre, Lower Galdeford, Ludlow, on the second Monday of month at 7.30pm.

Shrewsbury Micro Club meets at Shrewsbury Shirehall once a month. Mr V Ives, 6 Bramley Close, Severn Meadows, Shrewsbury SY1 2TP.

Telford Computer Club meets at Telford ITEC on Monday 6-9pm. John Murphy, 10 Brichmore, Brookside, Telford TF3 1TF. 0952 595959.

SOMERSET

Sharp MZ80 Club, Tim Powell, Computer Centre, Yeovil College, Yeovil, Somerset.

Yeovil Computer Club. D G Carrington, 2 Romsey Road, Yeovil, BA21 5XN.

STAFFORDSHIRE

Alsager Computer Club, meets at Alsager Comprehensive School, Stoke-on-Trent, Staffs, fortnightly on Tuesday. Rex Charlesworth, 09363 77270.

The Amateur Computer Club of North Staffs meets on the third Wednesday month. J Roll, 16 Hill Street, Hednesford, Staffordshire WS12 5DS.

ICL Birmingham Branch Micro Club, c/o WBA Ecclestone, 26 Browns Lane, Tamworth, Staffs.

Tame Valley Computer Club, Tim Marshall, 32 Milton Avenue, Leyfields, Tamworth, Staffordshire B79 8JG.

SUFFOLK

Newmarket Home Computer Group. Meets at Anchor House, Moat Lane, Towcester, at 7.30pm. Contact Simon Clark, 83 Watling Street, Towcester, Northants NN12 7AG, 0327 52191.

Suffolk Microcomputer Club meets monthly. Mr S Pratt, c/o Microtek, 15 Lower Brook Street, Ipswich.

SURREY

Ashted Computer Club meets on the last Thursday of month. Contact P Palmer, 8 Corfe Close, Ashted.

Deaf Microcomputer Users Group. Contact Chris Marsh, 3 Delaporte Close, Epsom, Surrey KT17 4AF.

Thames Valley Computer Club meets in Griffin Pub, Caversham. Phil Warn, Reading 594874.

Thames Valley Amateur Computer Club meets at Griffin, Caversham, on the first Tuesday of month. Brian Quarm, 25 Roundway, Camberley, GU15 1NR, Camberley 22186.

Ewell Micro Club, Dave De Silva, 316 Kingston Road, Ewell, KT19 0SU.

Farnham Computer Club, meets at Farnham 6th Form College, Morley Road, Farnham, on the second Wednesday of month. Adam Sharp, 14 Thorn Road, Boundstone, Farnham.

West Surrey Computer Club meets at Paddock Room, Green Man Public House, Burpham, Guildford, the first Thursday of month. Chris Karney, 0483 68121.

ITN Computer Club meets on Fridays. A Bond, 54 Farnham Road, Guildford, Surrey GU2 5PE, 0485 62035.

CBBS London meets on Sundays 4-10pm. P Goldman, PO Box 100a, Surbiton, KT5 8HY.

Sutton Library Computer Club meets at Central Library, St Nicholas Way, Surrey, on the first Friday of month at 6pm and second and third Tuesday of month. Dave Wilkins 01-642 3102.

Midhurst & District Computer User Group. Meets at the Grange Centre, Midhurst, at 7pm on the second and fourth Thursday of every month. Contact Val Weston, tel: Midhurst 3876.

Association of London Computer Clubs, Len Stuart, 89 Mayfair Avenue, Worcester Park, KT4 7SJ.

Worthing & District Microcomputer Club meets at Rose Wilmot Youth Centre, Littlehampton Road, Worthing, on alternate Sundays 11am-1pm. B. Thomas, 11 Gannon Road, Worthing, W. Sussex, BN11 2DT, 0903 36785.

Richmond Computer Club meets at Richmond Community Centre, Sheen Road, on the second Monday of month at 8pm. Bob Forster, 18a The Barons St Margarets, Twickenham, Middlesex, 01-892 1873.

SUSSEX

CVGC Video Games Club. Contact G Bond, 7 Swift Lane, Langley Green, Crawley Sussex.

West Sussex Microcomputer Club meets at Room R06, Robinson Road Annexe, Crawley, on the first and third Monday of month. J Clarke, 31 Hyde Heath Court, Pound Hill, Crawley, 0293-884207.

Mid-Sussex Microcomputing Club. Contact Jeff Hayden, 2 Hillary Close, East Grinstead, RH19 3XQ.

Arun Microcomputer Club meet at Wick Amenity Centre, Wick Farm Road, Littlehampton, on the first Monday of month at 8pm, and third Sunday of month at 6pm. P Cherriman, 7 Talbot Road, Littlehampton, West Sussex DN17 7BL.

Brighton, Hove & District Computer Club. Meets 7.30pm every second Wednesday at Southwick Community Centre. Contact J Smith, 30 Leicester Villas, Hove, E Sussex.

TYNE & WEAR

Newcastle upon Tyne Personal Computer Society meets at Room D103, Newcastle Polytechnic on the first Tuesday of every month. Pete Scargill, 21 Percy Park, Tynemouth, 0632 573905.

WEST MIDLANDS

Cannock Computer Society meets at Cannock Computer Systems, Old Penkridge Road, Cannock, fortnightly. Terry Sale, 20 Redwood Drive, Chase Terrace, Walsall WS7 8AS.

Coventry Computer Circle. Contact Chris Baugh, 9 Hillman House, Smithford Way, Coventry CV1 1FZ.

Walsall Computer Club meets at Park Hall Community School on the second and fourth Monday month 6.45-9.45pm. Alison Hunt, 58 Princes Avenue, Walsall, WS1 2DH, 0922 23875.

National Westminster Personal Computer Society. P Moore 021-236 6176, ext 382.

West Midlands Amateur Computer Club meets at Enfield School, Love Lane, Stourbridge, on the second and fourth Tuesday of month. John Tracey, 100 Booth Close, Brierley Hill, Kingswinford, 0384 70097.

WILTSHIRE

Chippenham and Calne, proposed new club. Matthew Jones, Pinhills, Calne SN11 0LY.

WORCESTER

Worcester & District Computer Club meets at Old Pheasant Inn, New Street, Worcester, on the second Monday month at 8pm. D Stanton, 55 Vauxhall Street, Rainbow Hill, WR3 8PA.

YORKSHIRE

Barnsley Co-Operative Computer User Group meets at Co-Op Social Club, Pogmore, Barnsley, on the last Tuesday month at 7.30pm. James Bridson, c/o 39 Kereforth Hall Road, Barnsley, South Yorks S70 6NF, 0226 41753.

Greenhead Grammar School Computer Club. Brian Smith, Greenhead Road, Keighley, West Yorks BD20 6EB, 0535 62828.

Huddersfield Computer Club meets every Monday. Chris Townsend, 760/4 Manchester Road, Linthwaite, Huddersfield, 0484 657299.

Leeds Microcomputer Users Group meets at 8 Regent Street, Chapel Allerton, fortnightly on Thursday at 6pm. David Parsons, 22 Victoria Walk, Horsforth LS18 4PL.

Program Power, R Simpson, 5 Wemsley Road, Leeds LS7 2BX, 0532 683186.

Pennine & District Computer Club meets at 26 Mill Hey, Haworth, W Yorks, on Saturday and Sunday. Douglas Bryant, 26 Mill Hey, Haworth, W Yorkshire, 0535 43007.

Shipley College Computer Group meets on Tuesdays. Paul Channell, tel: 0274 595731.

South Yorkshire Personal Computer Group meets at General Lecture Theatre, St Georges Building, Mappin Street, Sheffield, on second Wednesday month at 7.30pm. Paul Sanderson, 8 Vernon Road, Tetley, Sheffield S17 3QE.

Thurnscoe & District Micro Users' Club meets at Thurnscoe Comprehensive School, Physics Lab, Clayton Lane, Thurnscoe, Wednesday at 7.30pm during school term. Mr James Davis, 62 Tudor Street, Thurnscoe East, 0709 893880.

West Yorkshire Microcomputer Group meets on Tuesdays. Phillip Clark, c/o Suite 204, Crown House, Armley Road, Leeds LS12 2ES, 0532 632532.

York Computer Club meets at the Enterprise Club every Monday at 8pm. K Thomas, Green Lea, Ripon Road, Harrogate, HG1 2BY, 0904 38239.

SCOTLAND

Bisphopton Computer Club meets at 'Cwa Ben', Sachelcourt Avenue, Bisphopton, Renfrewshire, on Sunday once a month Alasdair Law, 10 Dunglass Road, Bisphopton, Renfrewshire PA7 5EF.

Edinburgh Home Computing Club meets at Claremont Hotel, Edinburgh, on the 2nd, 3rd and 4th Wednesday of month. I. Robertson, 031 441 2361.

Scottish Amateur Computer Society, Mike Anthony, 46 Moredun Park Gardens, Edinburgh EH17 7JR.

Central Scotland Computer Club meets at Falkirk College of Technology, Grangemouth Road, Falkirk, on the first and third Thursday of month. James Lyon, 78 Slamannan Road, Falkirk FK1 5NF.

Fife Computer Users Club meets fortnightly. Murray Simpson, 31 Tom Steward Lane, St Andrews, Fife, KY16 8YB.

Grampian Amateur Computer Society meets at 35 Thistle Lane, Aberdeen, on the second and fourth Monday every month at 7.30pm. Alan Morrison, 21 Beech Road, Westhill, Skene, Aberdeenshire AB3 6WR.

Kemnay Computer Club meets weekly. S Stubbs, 15 The Glebe, Kemnay, Inverurie, Aberdeenshire.

Inverness Personal Computing Club meets every second Tuesday at 7.30pm. Gyl Mackenzie, 38 Ardconnell Street, Inverness IV2 3EX, 0463 220922.

Perth & District Amateur Computer Society meets at Hunters Lodge Motel, Bankfoot, on the third Tuesday of month at 7.30pm. Alastair McPherson, 154 Oakbank Road, Perth PH1 1HA.

Strathclyde Computer Club meets at Wolfson Centre, 106 Rottenrow, Glasgow, on the third Wednesday of month. B Duffy, 24 Lomand Drive, Condorrat, Cumbernauld G4 8NW.

WALES

Abergele Computer Club meets at Abergele CI Offices every Thursday at 7.30-10pm. W Jones, 77 Millbank Road, Rhyl, Clwyd.

Colwyn Computer club meets at the Greens Hotel, Colwyn Bay, at 7pm. Contact D Bevan, c/o Abergele Road, Colwyn Bay, Clwyd LL29 7PA.

Connah's Quay Computer Club. Meets second and fourth Thursday of each month at the Community Centre, Cable Street, Connah's Quay, at 7pm. Contact G Johnson, tel Deeside 821945.

Gwent Amateur Computer Club meets at St Mary's Institute, Stow Hill, Thursday at 7.30pm. Rothery Harris, 16 Alanbrook Avenue, Newport, Gwent, Wales NPT 6QJ.

Mold Computer Club. Meets 7.30pm on first and third Thursday of each month at the Daniel Owen Centre, Earl Street, Mold. Contact G Johnson, 18 Daytona Drive, Northop Hall, Mold, Clwyd, Wales. Tel Deeside 821945.

Milford Central Computer Club. Open to schoolchildren, meets every lunch hour and evening. Contact Harry Evans, Milford Central School, Prioryville, Milford Haven, Dyfed, 043 784 571.

Llantwit Major Computer Club. Meets at Adult Education Centre, Llantwit Major, every Tuesday. Contact Douglas Mountain, 16 Denbigh Drive, Llantwit Major, South Glamorgan CF6 9GQ.

Pencoed Amateur Computer Club meets fortnightly on Saturdays at Pencoed Welfare Hall. Philip Williams, 38 Bryn Rhedyn, Pencoed, Bridgend, Mid-Glamorgan CF35 6TL, 0656 860307.

Pontypool Computer Club meets at The Settlement, Roackhill Road, Pontypool, Gwent, on Friday. Graham Loveridge, on Pontypool 2827.

Swansea & Southwest Wales Amateur Computer Club meets on the last Friday every month. Paul Griffiths, 1 Prescelli Road, Penlan, Swansea SA5 8AF.

Swansea Computer Club. Meets at No 10 (pub), Union Street every Tuesday at 7.30pm. Contact Robert Palmer, 044 123 602.

North Down Micro Users Club. Meets at Bangor Central Library, Hamilton Road every fourth Monday. Contact A Robson, 0247 67060.

Wrexham & District Computer Club. Meets each Thursday. Contact Mike Houghton, 1 Snerwell Avenue, Wrexham, Clwyd, Wales.

Remember

Let us know about your micro club or user group so we can be sure the information printed here is up to date. Drop a card to Wendie Pearson, Listings Editor, at *Personal Computer News*, 62 Oxford Street, London W1A 2HG, or give her a call on 01-636 6890.

DATABASICS

This week PCN Databasics lists a selection of add-ons for your micro. PCN keeps you up to date in three-week cycles, listing peripherals, then software, followed by micros.

Printers are best categorised by print-head type. The two most common methods of transferring type to paper are the **Dot matrix** and **Daisywheel** techniques.

A dot matrix printer uses a row of pins which are programmed to strike the paper through a ribbon and form the character as a pattern of dots.

The daisywheel acts more like a conventional typewriter, the character set being pre-formed on a wheel with each character on a separate spoke. As the interchangeable wheel rotates it is struck by a hammer to form the character impression.

Dot matrix printers tend to be faster than daisywheel but offer lower print quality.

In selecting a printer make sure the **interface** on your computer is compatible with those available as standard or at extra cost on the printer.

The ● sign means the interface is included in the price; ○ means you have a choice of interfaces included in the price; + means the interface will cost extra.

Max Baud rate indicates the approximate characters-per-second rate as they are fed into the printer.

The **buffer** stores characters sent by the computer. The printer can take characters in chunks, at a rate quicker than they are able to be printed, sometimes allowing the computer to be freed for further use.

Lines per inch indicates the maximum number of lines printed in a vertical inch. **Characters per inch** can be varied on some printers as the typesizes themselves can be adjusted.

Maximum print speed as indicated by the manufacturer tends to be a little optimistic. **Maximum print positions** tells you the optimum number of characters that can be printed in one line by the smallest character size on the printer. **Maximum paper width** is the widest paper the printer can take.

Size represents the space the printer takes up on a desk top. **The weight** of the printer is given in kilograms.

Maximum copies indicates the number of carbon copies that can realistically be produced at one time.

Underlining puts a line under characters while **bold type** thickens the characters to make them stand out. **True descenders** indicates that the print method allows for fully formed tails on letters such as p, g or q.

Proportional spacing puts the same space between characters whether they are a long 'm' or a short 'i'. **Block graphics** builds up pictures using rectangular blocks, while **High Resolution Graphics** uses smaller dots.

Bidirectional means the printer can save time by printing left to right and then doing the next line backwards right to left. Similarly, **Logic Seeking** enables the machine to save more time by printing the short lines without sweeping over the whole width of the page.

Feed methods comprise **fanfold** which uses continuous stationery sheets folded road-map style drawn into the printer by a tractor mechanism. The tractor cog fits into holes in the fanfold paper and takes the paper past the printer mechanism. **Roll** is a roll of paper that feeds into the printer, usually using **friction feed** where the paper is gripped between two rollers, typewriter-style. **Cut sheet** indicates the printer uses single sheets like a typewriter.

Distributor: to find which company distributes a particular add-on, use the code listed in this column to refer to the distributor table.

The table is at the end of the listings, and gives the distributor's name and telephone number.

PERIPHERALS

Make & Model	Price Inc VAT	Printhead type (M = matrix)	INTERFACES ● inc in price, ○ = options at extra cost (+)				Max baud rate	Buffer Memory Size (in characters)	Lines per inch	Characters per inch	Max print Speed (CPS)	Max print positions	Max paper width in inches	Size (base area in cms)	Weight (in kilos)	Max Copies	Underlining	Bold Type	True Descenders	Proportional Spacing	Block Graphics	High Resolution Graphics	Bi Directional	Logic Seeking	Feed Method					Distributor
			Centronics	20ma	RS232	Others ●	Others (+)																		Fan Fold	Roll	Cut Sheet	Tractor	Frictional	
Adler TRD 170	£833	Daisywheel	●	●	●	●	●	9600	256	6.8	10,12,15	17	198	15.5	56×37	13	6	●	●	●	●	●	●	●	●	●	●	●	●	T2
Anadex DP 9000A	£1,397	M 7×9, 9×9	●	●	●	●	●	9600	2700	6.8	10,12,15,16,7	200	106	9.5	40.9×57	13.6	6	●	●	●	●	●	●	●	●	●	●	●	●	I1
Anadex DP 9001A	£1,397	M 7×9, 11×9	●	●	●	●	●	9600	2700	6.8	10,12,15,16,7	200	132	9.5	40.9×57	13.6	6	●	●	●	●	●	●	●	●	●	●	●	●	I1
Anadex DP 9500	£1,397	M 9×9	●	●	●	●	●	9600	700	6.8	10,12,13,3	200	176	15.5	39×59.9	16	6	●	●	●	●	●	●	●	●	●	●	●	●	I1
Anadex DP 9500A	£1,397	M 7×9, 9×9, 13×9	●	●	●	●	●	9600	2700	6.8	10,12,13,3	200	176	15.5	40.9×70.3	16	6	●	●	●	●	●	●	●	●	●	●	●	●	I1
Anadex DP 9500L	£1,295	M 7×9, 9×9	●	●	●	●	●	9600	700	6.8	10	150	132	15.5	39×59.9	16	6	●	●	●	●	●	●	●	●	●	●	●	●	I1
Anadex DP 9501	£1,397	M 7×9, 11×9	●	●	●	●	●	9600	700	6.8	10,12,15,16,7	200	220	15.5	39×59.9	16	6	●	●	●	●	●	●	●	●	●	●	●	●	I1
Anadex DP 9501A	£1,397	M 7×9, 11×9	●	●	●	●	●	9600	2700	6.8	10,12,15,16,7	200	220	15.5	40.9×70.3	16	6	●	●	●	●	●	●	●	●	●	●	●	●	I1
Anadex DP 9620A	£1,489	M 7×9, 9×9, 13×9	●	●	●	●	●	9600	1500	6.8	10,12,15,16,4	200	216	15.5	40.9×70.3	16	6	●	●	●	●	●	●	●	●	●	●	●	●	I1
Anadex WP 6000	£2,616	M up to 18×20	●	●	●	●	●	19200	4500	6,8,12,16	10,12,16,7	285	220	15.5	46.7×74.9	25	6	●	●	●	●	●	●	●	●	●	●	●	●	I1
ASP 3500	£977	M 9×7, 9×9	○	○	○	○	○	9600	80	6.8	10,12,16,5	180	217	14	61.5×40.5	19	6	●	●	●	●	●	●	●	●	●	●	●	●	M1
Brother HRI	£747	Daisywheel	○	○	○	○	○	9600	2000	4,5,6	10,12,15	35	198	16.5	38.1×71.2	16	8	●	●	●	●	●	●	●	●	●	●	●	●	J1
Canon AP400	£1,140	Daisywheel	●	●	●	●	●	19200	4000	4,6,8	10,12,15	25	197	15.5	50.8×48.2	18.5	6	●	●	●	●	●	●	●	●	●	●	●	●	D1
Centronics 159/4	£962	M 9×7	●	●	●	●	●	9600	768	6	5,8,18,10,16,36	150	80	10	38×35.6	10	5	●	●	●	●	●	●	●	●	●	●	●	●	B1
Centronics 150/4	£682	M 9×7	●	●	●	●	●	9600	768	6.8	10,12,16,36	150	132	9.5	38.1×35.5	9.1	3	●	●	●	●	●	●	●	●	●	●	●	●	R1
Centronics 152/4	£788	M 9×7	●	●	●	●	●	9600	708	6.8	10,12,16,5	150	217	9.5	38.1×35.5	9.1	3	●	●	●	●	●	●	●	●	●	●	●	●	R1

PRINTERS

[illegible]

PRINTERS

PRINTERS

[illegible]

MONITORS

These have been split into colour and monochrome.

Screen size is a diagonal measurement in inches. Nearly all monochrome monitors accept a **composite video** signal from the computer and most computers are equipped with composite video output. Colour monitors feature a wider range of **signal** systems than mono and it is important to match the output of your computer to the input of the monitor.

Any audio channel will enable sound to be output from a speaker inside the monitor. **Mono tint** refers to the colour of the text on a mono monitor. Some monitors come with an **anti-glare filter** to relieve operator discomfort.

Band width refers to the frequency range of signals to which the monitor can respond in Megahertz. **Dot resolution** indicates the number of dots which can be displayed across the screen; the more dots, the sharper the picture.

Dimensions indicates the area the unit occupies on the desktop.

Make & Model	Price Inc VAT	Screen size (in inches)	Signal					Audio channel	Anti-glare filter	Band width (in Mhz)	Dot resolution	Dimensions (cms)	Weight (kilos)	Distributor
			Modulated PAL	Unmodulated PAL	TTL RGB									
					75 Ohm linear	32 bit 4 bit TTL								
COLOUR MONITORS														
Crofton C1401	£300	14				●			10	600	37×42	10	C4	
HM 2713	£3,120	13				●			25	720	54×40	36	B1	
HM 2719B	£2,553	19				●			25	960	50×49	46	B1	
HM 2719C	£3,042	19				●			25	960	50×49	46	B1	
HM 3619	£3,548	19				●			45	1280	50×44	48	B1	
Lion Cub 1431-TTL	£286	14				●			7	585	65×57.5	11.5	S6	
Lion Cub 1436	£316	14						●	7	585	65×57.5	11.5	S6	
Lion Cub 1439	£339	14					●		7	585	65×57.5	11.5	S6	
Lion Cub 1441-TTL	£546	14				●			15	585	65×57.5	11.5	S6	
Lion Cub 1445	£633	14						●	15	895	65×57.5	11.5	S6	
Lion Cub 1449	£604	14					●		15	895	65×57.5	11.5	S6	
Lion Cub 1451-TTL	£430	14				●			10	653	65×57.5	11.5	S6	
Lion Cub 1455	£483	14					●	●	10	653	65×57.5	11.5	S6	
Lion Cub 1459	£459	14						●	10	653	65×57.5	11.5	S6	
Lion Cub 2031-TTL	£344	20				●			7	585	65×57.5	11.5	S6	
Lion Cub 2035	£431	20					●	●	7	585	65×57.5	11.5	S6	
Lion Cub 2036	£390	20						●	7	585	65×57.5	11.5	S6	
Lion Cub 2039	£371	20						●	7	585	65×57.5	11.5	S6	
Lion Cub 2051-TTL	£646	20				●			10	940	65×57.5	11.5	S6	
Luxor Digital	£574	14				●		●	25	800	N/A	15.7	P1	

COLOUR MONITORS

Make & Model	Price inc VAT	Screen size (in inches)	Signal					Band width (in MHz)	Dot resolution	Dimensions (cms)	Weight (kilos)	Distributor	
			Modulated PAL	Unmodulated PAL	TTL RGB	75 Ohm linear	32 bit 4 bit TTL						Audio channel
Luxor Linear I	£597	14				●		●	25	800	N/A	15.7	P1
Luxor Linear II	£643	14			●			●	25	800	N/A	15.7	P1
Microtech 14	£402	14		●		●			18	585	33.7 x 40.8	12.6	M6
TM 22	£329	6				●			5.5	N/A	22x34.5	4.1	J3
VM 14 PSN	£378	14				●			5.5	300	47x40	13.6	J3
Wolf Cub 1435-TTL	£358	14				●	●		7	653	65x57.5	11.5	S6
Wolf Cub 1446-TTL	£587	14					●	●	15	895	65x57.5	11.5	S6
Wolf Cub 1456	£454	14					●	●	10	653	65x57.5	11.5	S6

MONOCHROME MONITORS

AVT DM 210G	£138	12	●	Green	●	12	750	30.8×29.6	9.5	L1
EG 100	£77	12	●	Green		8	700	37.5×29	8	L1
EG 101	£91	12	●	Green		12	700	37.5×29	8	L1
LEDM 091D	£99	9	●	B&W		●	750	22×24	5.4	L1
LEDM 0910	£121	9	●	Green		●	750	22×24	5.4	L1
Luxor 10	£212	10	●	Orange		●	625	N/A	8	P1
Luxor 15	£283	15	●	Orange		●	625	N/A	13	P1
M9	£131	9	●	Green		15-22	650	22.4×25.7	5.7	P1
M12	£144	12	●	Green		15-22	800	29.3×30	9.3	P1
Novex	£114	12	●	Green		12	750	N/A	N/A	P1
N12 1003	£112	12	●	Green		24	800	23×26.5	7	P1
Prince	£126	12	●	Green		24	800	33×50	7	C4
PM 102	£126	9	●	Green		●	800	22×28	7	C4
PM 1201	£138	12	●	Green		24	800	33×50	7	C4
Zenith ZVM121	£99	12	●	Green	●	15	N/A	29×29	6.5	P2
U300	£149	12	●	Green		●	N/A	34.8×36.8×29.2	7.7	R4
U300A	£153	12	●	Amber		●	N/A	34.8×36.8×29.2	7.7	R4

DISK DRIVES

This section is divided into categories covering 5¼in and 8in floppy disks. Disk data **capacity** is measured in kilobytes (K): one kilobyte = 1,024 characters. A **no of disks** column is included because some disk units contain two disk drives.

Manufacturers can vary the number of disk data **tracks** and these are divided into sectors. This **sectoring** system allows the information to be stored and retrieved by reference to a timing mark on the disk so the computer can keep track of its rotation. The system can be hard, where reference is kept by a hole in the disk, or soft, where the disk position is monitored by magnetic signals. Some drives have one read/write head for each side of the disk so the buyer has a choice between **single or double-sided** drives. **BS** means that the drives are both single and double-sided.

As disk technology advanced it became possible to cram more data onto the floppy so drives will feature either **single or double (data) density**. **BD** means that the drives are both single and double density.

The interface acts as an interpreter so the computer and disk can exchange information. Each device must have the same interpreter before a useful cable connection can be made. The **connect to** column allows you to match the disk interfaces to those included in the disk drives or available at extra cost.

Make and Model	Price inc VAT	Capacity	No. of disks	Tracks	Sectoring	Sides and density	Connects to						Distributor			
							I-EEE	RS232	BBC	Apple II	St. Shugart	Nasbus		Gemini	20ma	Others
5 1/4" DISK DRIVES																
Apple II	£399	143K	1	35	16	SS,SD				●						P2
Atari	£299	90K	1	40	Soft	SS,SD									●	A4
BASF 6106	£195	500K	1	48	Both	SS,BD								●		B6
BASF 6108	£240	500K	1	48	Both	DS,BD								●		B6
BASF 6118	£279	1Mb	1	96	Both	DS,BD								●		B6
Canon X8300	£600	640K	2	80	Soft	DS,DD									●	C5
CD 40	£679	400K	2	40	Both	SS,BD									●	C6
CD 50A	£424	500K	2	40	Both	SS,BD										C6
CD 50E	£569	1Mb	2	80	Both	SS,BD								●		C6
CD 50F	£712	2Mb	2	80	Both	DS,BD								●		C6
CD 80	£765	800K	2	80	Both	SS,BD									●	C6
CD 80D	£949	1.6Mb	2	80	Both	DS,BD									●	C6
Commodore 2031	£454	171K	1	35	Soft	SS,DD	●									C2
Commodore 4040	£799	343K	2	35	Soft	SS,DD	●									C2
Commodore 8050	£1,029	1Mb	2	77	Soft	SS,DD	●									C2
Commodore 8250	£1,489	2Mb	2	154	Soft	DS,DD	●									C2
Commodore VIC 1541	£345	171K	1	35	Soft	SS,DD									●	C2
Control Data 9408	£221	250K	1	40	Both	SS,BD								●		C7
Control Data 9409	£272	500K	1	40	Both	DS,BD								●		C7
Control Data 9409T	£420	1Mb	1	80	Both	DS,BD								●		C7
Control Data ZL141	£225	250K	1	40	Both	SS,DD								●		M5
Control Data ZL141B	£175	250K	1	40	Both	SS,DD								●		M5
Control Data ZL142	£360	500K	2	40	Both	SS,DD								●		M5
Control Data ZL241B	£240	500K	1	40	Both	DS,DD								●		M5
Control Data ZL291	£380	1Mb	1	80	Both	DS,DD								●		M5
Control Data ZL291*	£405	500/1Mb	1	40/80	Both	DS,DD								●		M5
Control Data ZL291B	£320	1Mb	1	80	Both	DS,DD								●		M5
Control Data ZL292	£640	2Mb	2	80	Both	DS,DD								●		M5
CS 40	£482	200K	1	40	Both	SS,BD									●	C6
CS 50A	£229	250K	1	40	Both	SS,BD								●		C6
CS 50E	£305	500K	1	80	Both	SS,BD								●		C6
CS 50F	£397	1Mb	1	80	Both	DS,BD								●		C6
CS 80	£523	400K	1	80	Both	SS,BD									●	C6
CS 80D	£627	800K	1	80	Both	DS,BD									●	C6
Cumana AS100	£252	200K	1	35	Soft	SS,BD									●	C6
Cumana DA8035	£857	655K	2	80	Soft	SS,BD									●	C6

Make and Model	Price inc VAT	Capacity	No. of disks	Tracks	Sectoring	Sides and density	Connects to								Distributor	
							I-EE	RS232	BBC	Apple II	St. Shugart	Nasbus	Gemini	20ma		Others
EG 401AT	£370	102K	2	40	Soft	SS,BD					●					L1
Gemini 825	£403	400K	1	80	Soft	SS,DD						●				G2
Gemini 825	£518	800K	1	160	Soft	DS,DD						●				G2
Gemini 825	£661	800K	2	80	Soft	SS,DD						●				G2
Gemini 825	£776	1.6Mb	2	160	Soft	DS,DD						●				G2
Lowe EG 400AT	£426	200K	2	40	Soft	SS,BD					●					L1
Lowe EG 400T	£253	102K	1	40	Soft	SS,BD					●					L1
M 4853	£311	1Mb	1	80	Soft	DS,DD					●					A3
M 4854	£368	1.6Mb	1	77	Soft	DS,DD					●					A3
Megastore MIQ5	£1,034	1.2Mb	2	80	Soft	DS,DD				●						V1
Multi Floppy Drive	£592	8Mb	5	770	Soft	SS,DD	●								●	H1
RM MDS-1	£1,950	144K	1	40	Soft	DS,SD			●						●	R3
RM MDS-2	£2,147	288K	2	40	Soft	DS,SD			●						●	R3
Scorpio 8	£863	8Mb	5	770	Soft	SS,DD	●									H1
Sharp MZ80 FB	£856	560K	2	70	Soft	DS,DD										S7
Tandy Colour	£449	175K	1	40	Soft	SS,DD									●	T1
Tandy 26-1160	£299	75K	4	40	Soft	SS,SD					●					T1
Tandy 26-3023	£299	156K	4	35	Soft	SS,DD					●					T1
Tandy Model 1	£389	90K	1	35	Soft	SS,SD									●	T1
Tandy Model 111	£369	175K	2	40	Soft	SS,DD									●	T1
TM 101-4	£282	1Mb	1	160	Soft	SS,DD	●									H1
TM 102-2	£393	2Mb	1	160	Soft	SS,DD	●									H1
TM 848-1	£389	800K	1	77	Soft	SS,DD	●									H1
TM 50-1	£147	250K	1	40	Soft	SS,DD	●									H1
TM 100-1	£158	250K	1	40	Soft	SS,DD	●									H1
TM 100-2	£221	500K	1	80	Soft	DS,DD	●									H1
TM 100-4/4M	£247	1Mb	1	160	Soft	DS,DD	●									H1
Tracker 1	£373	1Mb	2	80	Soft	SS,DD									●	D7
Tracker 2	£497	2Mb	2	80	Soft	DS,DD									●	D7

Make and Model	Price inc VAT	Capacity	No. of discs	Tracks	Sectoring	Sides and density	Connects to							Distributor	
							I-EEE	RS232	BBC	Apple II	St. Shugart	Nasbus	Gemini		20ma
8" DISK DRIVES															
ACP 700 (AC)	£293	1Mb	1	77	Soft	DS,DD								●	E2
ACP 750 (DC)	£316	1Mb	1	77	Soft	DS,DD								●	E2
ACP 1500 (DC)	£403	2Mb	1	77	Soft	DS,DD								●	E2
Caldisk 142M	£465	500K	1	77	Both	SS,BD								●	E2
Caldisk 143M	£522	1.2Mb	1	77	Both	DS,BD					●				F1
Caldisk 143M-1	£465	500K	1	77	Both	SS,BD					●				F3
Commodore 8280	£2,760	987K	2	77	Soft	DS,DD	●								C2
Canon X 8330	£1,200	2Mb	2	153	Soft	DS,DD								●	C5
Control Data 9404B	£684	800K	1	77	Both	SS,BD					●				M5
Control Data 9406-4	£1,144	1.6Mb	1	77	Both	DS,BD					●				M5
Eicon FD8/1D/DD	£1,438	1Mb	1	77	Soft	SS,DD					●				E3
Eicon FD8/1D/SD	£1,397	500K	1	77	Soft	BS,SD					●				E3
Eicon FD8/2D/FBR	£1,740	1Mb	2	77	Soft	DS,SD								●	E3
Eicon FD8/2D/DD	£2,013	2Mb	2	77	Soft	SS,DD					●				E3
Eicon FD8/2D/SD	£1,972	1Mb	2	77	Soft	SS,SD					●				E3
Eicon FD8/1D/FBR	£1,240	500K	1	77	Soft	DS,SD								●	E3
F 311	£1,725	1.2Mb	2	76	Soft	DS,SD								●	B5

8" DISK DRIVES

Make and Model	Price inc VAT	Capacity	No. of disks	Tracks	Sectioning	Sides and density	Connects to	Distributor
							Apple II BBC RS232 I-EEF St. Shugart Nasbus Gemini 20ma Others	
8" DISK DRIVES								
F 320	£2,300	2.4Mb	2	76	Soft	DS-DD		B5
M 2894	£499	1.6Mb	1	77	Soft	DS-DD		A3
M 2896	£493	1.6Mb	1	77	Soft	DS-DD		A3
Megastor 11 DD	£1,133	2Mb	2	77	Soft	DS-DD		V1
Megastor 11 SD	£1,018	1Mb	2	77	Soft	DS-DD		V1
Megastor 111	£1,121	2Mb	2	77	Soft	DS-DD		V1
R.M. FDS-2	£3,789	1Mb	2	77	Soft	DS-DD		R3
Tandy Model 11	£999	486K	1	77	Soft	DS-DD		T1
Tandy Model 16	£949	1.2Mb	1	77	Soft	DS-DD		T1
Tandy Model 16	£1,549	2.5Mb	2	77	Soft	DS-DD		T1

MODEMS

A modem interfaces a computer and the telephone system so computers can communicate over long distances. It converts data to electrical pulses or sounds that can be sent down the line. A modem can be connected to the line directly or acoustically. **A D** in the connection column represents direct link, while **A** indicates acoustic. The acoustic coupler is like a female telephone handset with a speaker in the coupler opposing the phone's mouthpiece and a microphone opposing the earpiece. **A B** in this column indicates that both methods of attachment are available. **Baud** rate shows the speed with which the data is transmitted.

The modem must be connected to the computer through an interface. The interface column lists the main interfaces featured on each modem. **Asynchronous** means that data may be transferred at intervals as available or as needed. **Synchronous** data is transmitted at regular intervals. **Simplex** transfers data in one direction, while **Half duplex** can transmit/receive in either direction, but not simultaneously. **Full duplex** transmits and receives information in both directions at once.

Some modems can **originate** a call or start a two-way conversation. **Answer** means they can respond to a call from another computer.

Make and Model	Price inc VAT	Connection	Data Rates (baud)	Interface	Others	Capabilities	Distributor Code
						Asynchronous Synchronous Simplex Half Duplex Full Duplex Originate Answer	
AJ 311	£320	B	300	RS232			A5
AJ 1222	£736	D	1200	RS232			A5
AJ A211	£263	A	300	RS232			A5
AJ 1234	£684	A	1200	RS232			A5
AJ 1256	£684	B	1200	RS232			A5
AM 211	£387	B	300	RS232			A5

DISTRIBUTORS

A1 Appropriate Technology, 01-625 5575 **A2** Advent Data Products, Melksham 706289 **A3** Altex Microcomputers Ltd, Reading 791579 **A4** Atari International (UK), Slough 33344 **A5** Anderson Jacobson Ltd, Slough 25172
B1 Bytech, Reading 61031 **B2** British Olivetti, 01-785 6666 **B3** Barron McCann, Biggleswade 316286 **B4** Bencorn Sendata (UK), 01-940 1386 **B5** Baydel Ltd, Leatherhead 37881 **B6** BASF, 01-388 4200
C1 Centronics, 01-581 1011 **C2** Commodore Business Machines, Slough 79292 **C3** Calcomp Ltd, Bracknell 50211 **C4** Crofton Electronics, 01-891 1923 **C5** Canon (UK) Ltd, 01-680 7700 **C6** Cumana, Guildford 503121 **C7** CBL, Reading 792097
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E1 Epson (UK), 01-900 0466 **E2** Eleomatic, 041-881 5825 **E3** Eicon, Barhill 81825 **E4** Environmental Equipments Northern Ltd, Nantwich 625115
F1 Fastcol, Reading 791557
G1 Geveke Electronics, Woking 26331 **G2** Gemini Micros, Amersham 28321
H1 HAL Computers Ltd, Farnborough 517175 **H2** Hayward Electronic Assoc. Ltd, 01-428 0111
I1 Informex Ltd, 01-318 4213 **I2** Intac Data Systems, Rotherham 547170 **I3** ITT Business Systems, Brighton 507111 **I4** ITT Consumer Products, Basildon 3040 **I5** Intelligent Interfaces, Stratford-upon-Avon 296879
J1 Jones & Brother, 061-330 6531 **J2** J J Lloyd Instruments, Loughborough 4221 **J3** JVC, 01-450 2621

Bermac 1200/1 Model A	£414	D	1800	RS232	B3
Bermac 1200/1 Model B	£460	D	1800	RS232	B3
CCITT CAT	£228	A	300	RS232/V24	D8
CDSV22	£719	D	1200	RS232/V24	D8
DSL2123	£329	D	300/1200	RS232/V24	D8
Sendata 700 Series A	£253	A	300	RS232, 20ma	B4
Sendata 700 Series B	£224	A	300	RS232, 20ma	B4
Sendata 700 Series C	£309	A	600-1200	RS232, 20ma	B4
Sendata 700 Series D	£309	A	75-1200	RS232, 20ma	B4
Sendata 700 Series E	£149	A	300-1200	RS232, 20ma	B4
Racal 126 LS1	£782	D	2400	V24	R2
Racal MPS 3021	£295	D	300	V24	R2
Racal MPS 1222	£678	D	1200	V24	R2

PLOTTERS

Plotters use a pen to put graphics or characters on paper under the command of a computer. They are usually one of two types—flatbed or drum. A **flatbed** holds the paper flat while the pen draws on it in two dimensions. A **drum** plotter turns the paper vertically on a cylinder while the pen moves horizontally. Most plotters can change pens during operation so a variety of colours and line thicknesses are available. **Max pens** indicates the number of pens in operation or on standby. Dimensions of the paper to be used are listed under **paper size**. **Maximum plotting speed** measures the distance in millimetres per second covered by the pen. **Interfaces** are included in the basic price or come at extra cost.

Make and Model	Price inc VAT	Type	Max Pens	Paper Size	Maximum Plotting Speed in secs	Interface (+at extra cost)	Distribution
Calcomp 81	£3,392	Flat	8	A3	30cm	RS232 or IEEE	C3
DXY 100	£699	Flat	1	A3	7	Centronics	R4
HP 7470A	£1,317	Drum	2	A4	38.1cm	RS232 (IEEE+)	H2
PD4	£585	Flat	1	A4	700mm	(IEEE+)	J2
Strobe 100	£662	Drum	1	A4	7.6cm	(RS232, Parallel+)	D6
TRS-80 Pen Plotter	£1,399	Flat	6	A4	6.8cm	RS232	T1
Watanabe WX 4633	£2,772	Flat	10	A3	250mm	(Centronics, RS232, IEEE+)	E4
Watanabe WX 4634	£2,515	Flat	2	A3	250mm	(Centronics, RS232, IEEE+)	E4
Watanabe WX 4635	£2,301	Flat	1	A3	250mm	(Centronics, RS232, IEEE+)	E4
Watanabe 4636	£3,074	Flat	10	A3	400mm	(Centronics, RS232, IEEE+)	E4
Watanabe 4637	£2,862	Flat	2	A3	400mm	(Centronics, RS232, IEEE+)	E4
Watanabe 4638	£2,635	Flat	1	A3	400mm	(Centronics, RS232, IEEE+)	E4
Watanabe WX 4671	£1,129	Flat	1	A3	50mm	Parallel (RS232, IEEE+)	E4
Watanabe 4675	£1,638	Flat	6	A3	50mm	Parallel (RS232, IEEE+)	E4
Watanabe 4731	£1,761	Drum	4	A3	200mm	(Centronics, RS232, IEEE+)	E4

L1 Lowe Electronics, Matlock 4995
M1 Mitsui & Co Ltd, 01-600 1777 **M2** Modata, Tunbridge Wells 41555 **M3** Mannesmann Tally Ltd, Reading 788711 **M4** Micropute, Macclesfield 615384 **M5** Microwave, 01-272 6237 **M6** Microtech Leeds, Leeds 679964 **M7** Micro Peripherals Ltd, Basingstoke 3232
N1 Newbury Data Recording, Newbury 48864
P1 Phoenix Technology, 01-737 3333 **P2** Pete & Pam Computers, Rossendale 227011
Q1 Qume (UK) Ltd, Reading 584646
R1 Rair Ltd, 01-836 6921 **R2** Riva Terminals, Woking 71001 **R3** Research Machines Ltd, Oxford 249866 **R4** Roland (UK) Ltd, 01-568 4578
S1 Sintron Electronics, Reading 875464 **S2** Sord, 01-930 4214 **S3** Stottron, Coventry 613521 **S4** Systime, Leeds 702211
S5 Sinclair Research, Camberley 681666 **S6** Silicon Express, Leicester 374917 **S7** Sharp Electronics, 061-205 2333
T1 Tandy Computers, Walsall 648181 **T2** Triumph Adler, 01-250 1717 **T3** Technology For Business, 01-837 1271 **T4** Toshiba Office International, Sunbury-on-Thames 85666
V1 Viasek, High Wycombe 448633
W1 Walters Microsystems Int Ltd, High Wycombe 445175
X1 X-Data Ltd, Slough 723331
Z1 Zygal Dynamics, Bicester 3361

PCN AUGUST 4-AUGUST 10, 1983

PCN Billboard

Sharp MZ80-K with lots of software for sale, all you need for £265. Also Atari VCS with five boxed games, £120. Tel: (0202) 707840.

Sinclair ZX Spectrum 16K, as new together with Spectral Invaders and Meteoroids, offers around £75. Tel: 01-954 8753.

Wanted 16K ZX81 with a couple of games for £40. Selling Tandy TV game, 88 game variations for £15 bargain. 7 Gladstone Terrace, Whitley Bay, Tyne and Wear NE2 6EH, ask for Paul Kelly.

For sale video genie (Model 1) includes £60 of software, colour board, sound unit (not fitted) and computer books, £160 ono. Tel: Bloxwich 406386.

Acetronic MPU VCS Musical Games cartridge only £8 ono. Complete Acetronic VCS system with Invaders, Laser, Blast, Super Knockout and above £75 ono. Borland, 51 Lovell Gardens, Watton, Norfolk IP25 5CX.

Atari VCS cartridges, Activision, Kaboom, Fishing Derby, £12. Dragster, £10. Circus, Outlaw, Miniature Golf, Adventure, Human Cannonball, Basketball, Basic Programming, Basic Maths, Boxing, £10 each. Borland, 51 Lovell Gardens, Watton, Norfolk IP25 6ZX.

Sharp PC1500 pocket computer with 4K RAM plus printer/cassette interface. Cost £350, sell £255. Tel: Newmarket (0638) 665812 evenings, Mr Houghton, Warren Towers, Moulton Road, Newmarket, Suffolk.

Dragon 32K with manual, Dragon joysticks, Tandy tape recorder (with leads) and £30 worth of software. Worth approx £300, will sell for £250. Tel: Ingelstone 3535 24 after 4pm.

BBC ModB with joysticks, £600 of software, assembly language book and many magazines, will accept £400, negotiable. Tel: 01-833 1440 quickly!

SWAP Savage Sword Conan Nos 1-17 (rare!) plus 80 Mad magazines (mint) for ZX81. P. Mottram, 13 St Johns Grove, Hull, Humberside.

16K ZX81, printer and four cassettes of software, £85 ono. Tel: 051 924 6473.

Wanted ZX Spectrum 16 or 48K, must be in good condition, will pay up to £80 max. Tel: (0384) 277146.

Atari 800 48K plus cassette, joysticks, £150 worth of software plus lots magazines, only £350. Tel: 01-251 3769 after 5.30pm.

Unwanted Spectrum ZX81 software Transylvanian Tower 3D adventure for Spectrum 48K, £4, Mad Martha Spectrum, £4, ZX81 Kong, £3 unused, S.a.e. A. Fletcher, 11/4-27 Castlebay Drive, Milton, Glasgow G22 7LJ.

Acetronic video game Invaders, Maze Craze, Air Sea Battle, Planet, Defenders and Olympics. Only £50 ono for quick sale. Tel: Ashton-in-Makerfield 726456.

Wanted Vic20 cartridge programs, only adventures needed, with instructions please. Reasonable prices paid, including postage. Tel: 021-554 8624 after 4pm, ask for Manjit.

Atari VCS as new with seven cartridges including Pacman, unique American Spacechase and new Star Raiders, all boxed as new, genuine reason for sale, only £100! Tel: Leeds 400821.

Vic20 computer, few months old, in excellent condition, plus 3K RAM cartridge, virtually unused. Also the book Vic Revealed and owners manual. Only £118. Tel: Macclesfield 24060.

Vic20 The Count swap or sell, £17, also Alien Blitz, £5. Tel: Rochdale 44003.

16K ZX81 computer, 4K graphics ROM, keyboard, sound board, games worth over £200, for sale for £85. Tel: Gt Yarmouth 664025.

48K Spectrum, printer, joystick, amplifier, £20 worth of printer paper, software and books worth £100. Cost me £400, cost you £200, good condition. Tel: (087255) 2842.

Commodore 64 brand new, used once, two months old with direct cassette unit and software tape. Value over £400, accept £299 ono. Tel: 570 8517 after 5.30pm.

16K RAM pack for ZX81 £6.50, 16K Galaxians, Fun to Learn inventions, History, Super programs series 3, 4, 10 games all £10. Tel: Stockton 602936.

TRS-80 16K L2 good condition, plus B/W TV and CTR-80A recorder, all leads, manuals, books, and loads of programs included. Price wanted only £390 ono. Tel: (Watford) 31421.

ZX81 Sinclair built 16K, leads, manual, Pimania etc, £45. Also Black Crystal adventure for 48K Spectrum, £4 or swap. Tel: Barford 624574.

Sharp P6 printer, friction/tractor, interface, cable, manuals, £350. Tel: Reading 584497, Winbow, 102 Sherwood Street, Reading, Berks.

Arfon expansion unit for Vic20. Make your computer into a real system, seven slots for cartridges, memory aids, etc. Absolute bargain at £50, as new. Tel: Havant 486748.

Atari Video Computer System with Dodgems, Maze Craze, Asteroids, Haunted House, Indy 500 (+ controller), all worth over £250, will sell for £125. Tel: (0202) 707840.

Casio FX602P Alphanumeric programmable calculator with FA2 cassette adaptor and programs including Flight Simulator and music, cost £95, asking £70 ono. Tel: Mildenhall (0638) 713933.

Tandy Colour Computer, large selection of software, ready to swap? Tel: South Benfleet 4965.

Spectrum educational software for sale, for infants and juniors, five stimulating games for £4.95. Used once only. M. Bristow, In-Vid-Ria, Route Charles, S.P.P., Guernsey, Channel Isles, require immediate sale.

ZX81 Gateway Guide book by Mark Charlton, £3. All 12 PCNs 50p each. Other weeklies any offers? Write J. Allen, 1 Kingsfield Close, B-on-A, Wiltshire.

Wanted 16K ZX81 home computer plus cassette, exchanged Acetronic video game with three cassettes plus handheld Arcade Defender with everything including gamespeed control: 2 Recreation Road, Southall, Middlesex UB2 5PE.

Wanted: Vic20 Super Expander cartridge, will swap Wacky Waiters, Multi-sound synthesizer, Amok, Space Phrecks and Blitz Cassettes for the cartridge. Tel: Dungannon (08687) 25324.

Wanted for ZX81 a suitable tape recorder for under £20 ono. Tel: Rugby 77835 after 5.00pm, M. Templeman.

Spectrum software, swap Penetrator, Mined-out GB Ltd, Masterfile, Timegate for Trader, Terror Partik, VU3D, Warlord, Dictator and other high quality 48K games. Tel: Michael 01-340 2630.

Acorn Atom, 12K RAM + 24K ROM, 5 amp PSU, all connectors and buffers, lots of software, £175. BBC conversion board, £30. Tel: 01-422 4573.

Spectrum, 50 games for sale, only £5 or swap for Penetrators, Gobble-A-Ghost or Orbiter (original tapes only). Tel: Dinington 568580 after 4.30pm.

Tuscan S100 8K ROM Basic 64K RAM card with 32K CMOS RAM, stereo sound card, Centronic RS232 ports, £299. Tel: Upminster 24145 after 6pm.

Acorn Atom 12K + 12K with F.P., all leads and mains adaptor, some games and books, £120. 198 Thornhill, Rastrick, Brighouse. Tel: 0484 717476. Philip Ambler.

Dragon 32 and Tandy Colour Computer

Copycat. This program copies machine code tapes. Send £3 and s.a.e for a listing. Richard Hunter, 1 Greet Park Close, Southwell, Notts NG25 0EE.

16K ZX81, 11 magazines, four tapes, worth £90, sell £55 (good condition). Tel: Haywards Heath (0444) 451381, after 4pm.

Dragon 32 software, Wizard War and Dragon Trek, £10pa also Program Pack 2 and Dragon Selection £10. All as new. Tel: Sheffield 0742 550326.

Atari 400 software, four Atari games, including Star Raiders, £20 each, also Crypts of Terror (graphic adventure) £10. £80 the lot. Tel: 0484 29182.

Spectrum, 16K games-Mcorder (£6.50), Gulpman (£3), Space Raiders (£3), Artic, Microchess (£5), or £16 for all (cost over £26). Tel: Kers (Coventry) 4699.

Swap Spectrum software please. Tel: Leigh (0942) 67129 weekends.

Wanted BBC (B) circuit diagrams, also BBC (B) disk interface fitting instructions. Original or photostat copies. Will pay £5 each. Tel: Idris 0384-64345 day; 021773 2869 evenings.

Spectrum software to sell or swap for other software: 3D Tunnel, GB Ltd, Hungry Horace, Horace Goes Skiing, Timegate, Niteflight, Penetrator. Tel: 0279 36274.

BBC dual disk drive, Canon MD220 80-track d/sided 800K with 40/80 track switches and BBC cable. Cased with power supply, brand new, bought in error. £625. Tel: 051-644 6568. Disk and manual included.

ZX81 16K, Filesixty keyboard video invert (switchable), keyboard beep, keyboard repeat (switchable); software: VU-File, Fast One, 3D Maze, City Patrol, 30 Hr-Basic book, executive case. Tel: Davis, 01-883 7286.

Philips G7000 as new including instruction book and five games cartridges: Pacman, Laser War, Space Monster, Billiards, £100 the lot. Hanson, 47 Quinton Road, Sittingbourne, Kent ME10 2DB.

16KZX81 four months old, 20 (or more) games + leads + 14 mags + manual, worth £125, selling for £85. Want Vic 20 with cassette player for £100 or under or 16K Spectrum for under £100. Tel: 01-504 7203 (after 7pm).

Swap, Trader by Pixel/Quicksilver (Spectrum 48K) for Pimania and Timegate (Spectrum 48K) for Penetrator (Melbourne House). Tel: Bishops Stortford 722033 (after 6pm).

Wanted disc drive for BBC B (TEAC CDC Shugart etc). Can afford around £100, will pay carriage. Roger. Tel: 04465/3684 (evenings).

Sharp MZ-80K, Integral cassette and VDU, suit home or business plus games, just £325. Tel: Poole (0202) 707840.

!!!@*** unwanted birthday present CMB64, mint condition plus joystick, software, books and technical data, all going for? Or swap for BBC model B, or any other computer. D. Scott. Tel: 01-673 0219. Will deliver.

Vic-20 home computer, cassette player, various games. Tel: 0939 260 887.

Lynx 48K new, hardly used, boxed guaranteed with manual, only £200. Tel: Runcorn (09285) 67095.

16KZX81 & DK trionics, cased keyboard 4K graphics board and motherboard and numeric keyboard, £57 of software including Scramble, Defender, Chess, leads, manuals, cost £227 accept £111, insured. Duncan. Tel: (0284) 62508.

Commodore. C2N cassette recorder plus introduction tape, still in box, good as new, sell for £20 ono. Tel: Penketh 7878. Will swap Atari games console, plus

Intellivision, both excellent condition, plus four Intellivision cartridges for Vic 20 16K or above plus C2N tape recorder. Tel: 01-980 7058 (Timperly).

Atari VCS, cartridges Imagic Demon Attack, Atlantis, Cosmic Ark, Riddle of the Sphinx, Firefighter, Activision Chopper Command, only £15 each. Borland, 51 Lovell Gardens, Watton, Norfolk.

ZX81 16K manual 4 tapes, books etc. £45. Tel: 0442 (Hemel) 68860 (evenings).

ZX81 +16K with power-pack, leads and manual. Excellent condition, bargain at £30 buyer collects. Martin. Tel: Wakefield (0924) 279606.

CGL Puck Monster and Galaxy Invader 1,000 plus Master Challenge, all excellent condition, worth £55, sell for £45 or swap for ZX81. Tel: Hemel 50705.

Atari 800, 48K with Basic Programming kit, Atari 410 Program Recorder, joysticks, and 16 games, including Zaxxon, three months old, £250. Tel: Aylesbury 24100.

Starlord (25,101) players, make diplomatic contact, join alliance? Non-players wanting information about this play by mail game. (ssac) P. Moreland, Basement Flat C, 4 Hedgedge Powis Terrace, London W11.

Atari 400 software, adventures 4, 5, 8, 9, 12 £10 each, Flight Simulator, Shamus, Sub Commander £22 each, Star Raiders, Centipede £20 each., Star Warrior, Protector, Astrochase, Bug Attack, Bajabuggies, Applepanic, Rescue at Rigel, £18 each, also some others. Tel: Sunbury 82189 (evenings).

Spectrum software (original tapes) Hobbit, Timegate, Cyber-Rats Cosmos Arcade-Pack Arcadia Avenger plus many more! All half price. Tel: Bri (0273) 412409.

Microline 80 printer—RS232 interface—1½ years' old—home use only. Offers over £120. Tel: 0565-830277, (Knutsford area).

Wanted for Atari computer disc and cartridge games especially Star Raiders, Pacman and Centipede. Tel: Cardiff (0222) 753585 (after 5pm).

Acorn Atom fully expanded with utility ROMs, Eprom Programmer, printer cable, software, 5 amp 5 volt PSU, and many listings, £170 ono. Tel: 01-954 1903 (evenings).

BBC software Acornsoft, 1JK and superior software will swap for other games. Tel: (0292) 70929.

Sale, ZX81 software new all utilities. Pyatt, 23 Arundel Drive, Orpington, Kent.

Vic 20 C2N Super Expander, monitor and two other cartridges, all boxed, Prog Ref. Guide, Vic Revealed, other books, hardly used, worth over £300, accept £250 ono. Tel: (0634) 364929.

ZX81 software sale, most £2, arcade games, adventures all well known companies, sae for list. G. Birce, 4 Calverley Garth, Leeds LS13 3LJ.

Dragon 32K joysticks and £150 cassettes, games and books, still boxed and under guarantee, £250 ono. Tel: Weybridge 41955.

Spectrum software for swapping including Penetrator, Timegate, Battle of Britain, Centipede etc plus many more. Swap for other programs or ZX81 or any Spectrum add-ons, eg joystick. Tel: 0376-511973.

Commodore 64 cassettes, Panic 64 £5.50, Frogger 64 £5.50, Mutant Camels £6.50, all three are original manufacturer's cassettes. Tel: Havant 486748.

BBC disk drive, Canon MD220, 80 track, dual double sided cased with power supply 40/80 track switches, BBC lead. Brand new, unused. Bought in error. First £625. Tel: 051-644-6568. Disk and manual included.

Free Seikosha GP80A printer with paper and manual when you buy my printer cable, £140 for quick sale, will not split. Tel: (0472) 48531 (after 6pm).

Syntax Errors

Stray paint

The words print and paint will have caused confusion in last week's article on Grafkey and Draftmate packages for the BBC. In a table listing their facilities we switched words so print appeared instead of paint.

Nought again...

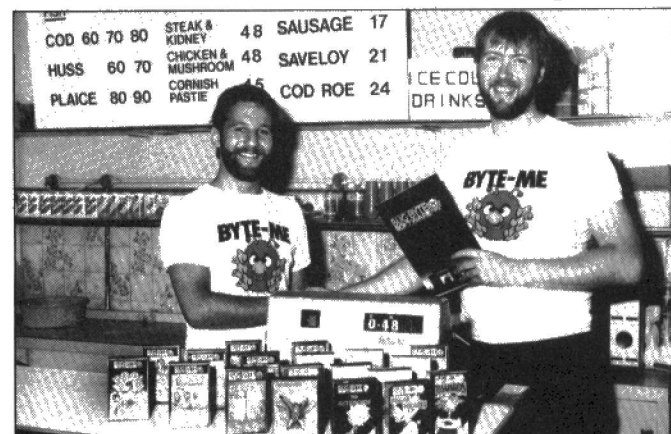
We did an injustice to Hewlett-Packard's new desk top system in last week's issue when a slipped digit led to it being described as having the power of a Motorola 6800. It should have been 68000.



Next week

- **Peripherals** — Full test of Sir Clive's Microdrives
- **Hardware** — Pro-Test of the Tandy Model 4
- **Software** — Sharpen your Sord with the new Basic-G package
- **Gameplay** — More fun for Atari, Spectrum, Oric and Dragon
- **Micropaedia** — Pull out part two of this guide to CP/M
- **Specials** — First of two parts to help you program titles on your Dragon
- **PLUS**, full review of new 3in disks for the BBC, how to program your Atari joystick, all the latest news in Monitor, more ProgramCards, and all the regulars...

The batter software shop

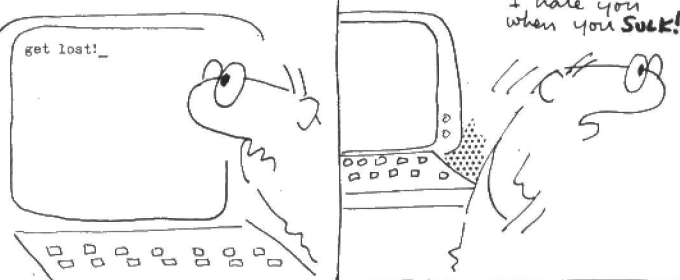


Well, someone had to do it... and we'd like to award Bug Byte the cringe-of-the-week award for coming up with it. As you see, here we have fish and chips which, according to the

fish bar owner, is a 'recipe for success'.

It's clearly to the taste of Bug Byte, for the software company is using the idea to head its launch into small shops in the belief that there's great sales potential in putting packages next to paper-wrapped plaice. Book shops, record shops and newsagents are also on Bug Bytes list of possible outlets.

Now we're looking forward to the day you can walk into your local computer store and come out with crispy cod. On the other hand, this could all be a bit of a red herring.



PCN DATESLINES

PCN Datalines keeps you in touch with up-coming events. Make sure you enter them in your diary.

Organisers who would like details of coming events included in

PCN Datalines should send the information at least one month before the event. Write to PCN Datalines, Personal Computer News, 62 Oxford Street, London W1A 2HG.

UK EVENTS

Event	Dates	Venue	Organisers
8th ZX Microfair	August 20	Alexandra Palace, London	Mike Johnstone, 01-801 9172
Acorn User Exhibition	August 25-18	Cunard International Hotel, London	Computer Marketplace Ltd, 01-930 1612
Strathclyde Home Computer Fair	August 26-27	McLellan Galleries, Sauchiehall Street, Glasgow	Jarak Sales, 25 Dungavel Gdns, Silvertonhill, Hamilton, Scotland. 0698 457204
Computer Open Day	September 1	Draganora Hotel, Leeds	Tony Kaminiski, Couchmead Communications Ltd, 01-778 1102
Video, Audio and Computer Show	Sep 16-18	Bradford Exposition Centre	R. Cooper, J. Wood & Sons Ltd, Bradford 720014
Home Entertainment Show	Sep 17-25	Olympia, London	Montbuild Ltd, 01-486 1951
Computer Open Day Exhibition	September 22	Central Hotel, Glasgow	Couchmead Communications Ltd, 01-778 1102
Microcomputers in Business	Sep 27-29	Warwick University, Coventry	Peter Bubb, 01-892 4422
Personal Computer World Show	Sep 29-Oct 2	Barbican Centre, London	Montbuild Ltd, 01-486 1951
Computer Fair	Oct 2	The Sir Frederic Osborn School, Welwyn Garden City	R Brown
European Computer Trade Forum	Oct 4-7	NEC, Birmingham	Welwyn Garden City 23367 Clapp & Poliak Europe Ltd, 01-747 3131

OVERSEAS EVENTS

Event	Dates	Venue	Organisers
National Computer Business & Office Systems	Aug 16-19	Auckland, New Zealand	Trade & Industrial Exhibitions, 12 Heather Street, Parnell, PO Box 9682, Auckland
Personal Computers & Office Automation Systems Exhibition	Sep 5-8	Amsterdam, The Netherlands	RAI Gebouw BV, Europaplein 2, 1078 GZ, Amsterdam
Australian Computer Exhibition	Sep 13-16	Melbourne, Australia	Riddell Exhibition Promotions PTY Ltd, 166 Albert Road, South Melbourne, Vic 3205
International Peripheral Equipment & Software Exposition	Sep 13-15	Moscone Centre, Anaheim, USA	Cahners Exposition Group SA, 0483 38085
Gulf Computer Conference	Nov 22/23	Dubai International Trade Centre	Reed Conferences, Surrey House, Throwley Way, Sutton, Surrey. 01-643 8040

ocean

NUMBER 1

IN GAMES SOFTWARE

PRESENTS SIX OF THE BEST

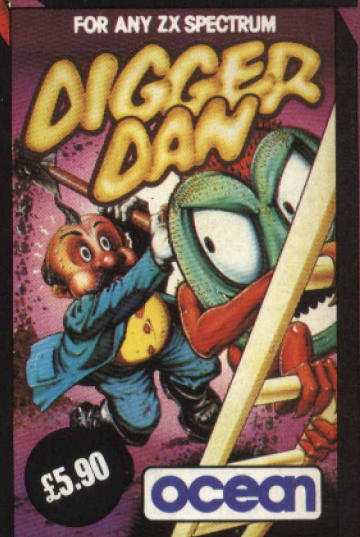
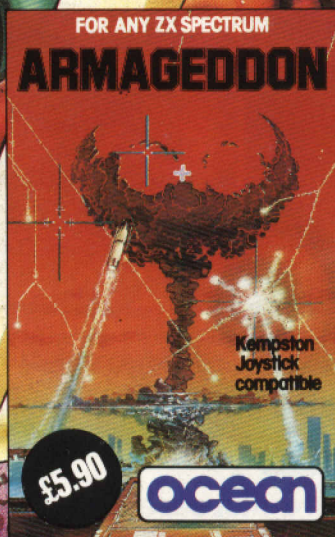
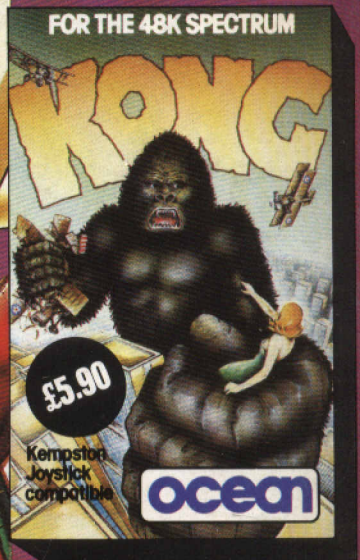


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